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Belladonna

Illustrated.

Contributions from

Henry Kraemer, Ph.G.
Chas. Rice, Ph.D.
Prof. John M. Maisch.
Prof. J. U. Lloyd.
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Prof. A. R. L. Dohme.
Robt. W. Johnson.
And others.

Translations, Abstracts,
and Therapeutic Index
from Leading Authors.

NEW YORK, U. S. A.

JOHNSON & JOHNSON, PUBLISHERS.

1894.

Edited by
F. B. KILMER.

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Belladonna

A STUDY OF ITS HISTORY, ACTION
AND USES IN MEDICINE.

Illustrated.

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List of Special Contributions, Translations and Abstracts.

Contributions.

- "The Pharmacognosy of Belladonna," edited by HENRY KRAEMER, Ph.G.; Reporter Progress of Pharmacy, American Pharmaceutical Association.
- Note on "Derivation of the Word Belladonna," CHARLES RICE, Ph.D., Chairman Committee of Revision Pharmacopœia of the United States, 1880-1890, 1890-1900; Chemist Department Public Charities and Correction, New York.
- Note on "Starch of Belladonna Root," EDSON S. BASTIN, Prof. of Botany and Pharmacognosy, Philadelphia College of Pharmacy.
- Notes on "Pharmacognosy of Belladonna and Revision of MSS.," the late JOHN M. MAISCH, Phar. Doc., Prof. Materia Medica and Botan., Philadelphia College of Pharmacy; Secretary American Pharmaceutical Association.
- Note on "Insects Attacking Belladonna," Prof. C. V. RILEY, Entomologist Department of Agriculture, Washington, D. C.
- Note on "Insect Attacking Belladonna Root," and delineation of plates, JOHN BERNHARD SMITH, Sc.D., Prof. Entomology Rutgers College; Entomologist New Jersey Agricultural Experiment Station.
- "Official Preparations of Belladonna," United States Pharmacopœia, 1880, JOSEPH P. REMINGTON, Ph.M., F.C.S., Prof. of Theory and Practice of Pharmacy, and Director of the Pharmaceutical Laboratory, Philadelphia College of Pharmacy; first Vice-Chairman Committee of Revision and Publication Pharmacopœia, 1890-1900; Pharmaceutical Editor United States Dispensatory, etc., etc. By special permission from *The Practice of Pharmacy*.
- "Belladonna in the New Pharmacopœia (1893)," R. G. ECCLES, M.D., Ph.G., Committee of Revision, U. S. Pharmacopœia, 1890-1900; Government Chemist for Inspecting Medical Supplies, Department of the Interior; Official Chemist Brooklyn United Retail Grocers' Association; Chairman Chemical Committee on Adulterations, New York State Pharmaceutical Association; Member Executive Committee, Chemical Section, Brooklyn Institute.
- "Extraction of Belladonna," revision of MSS. and notes, JOHN URI LLOYD, Prof. of Pharmacy, Cincinnati College of Pharmacy.
- "Making Belladonna Plasters," ROBERT WOOD JOHNSON, Manufacturing Chemist, President Johnson & Johnson Corporation.
- "New Reactions for Atropia" and notes, ALFRED R. L. DOHME.
- "The Physiological Action of Belladonna," H. C. WOOD, M.D., L.L.D., Prof. Materia Medica and Therapeutics, and Clinical Professor of Diseases of the Nervous System in the University of Pennsylvania. By special permission from *Therapeutics, Its Principles and Practice*.
- "Local Action of Belladonna," W. C. CALDWELL, M.D., Prof. Materia Medica, College of Physicians and Surgeons, Chicago.

79538

- "Local Therapeutics of Belladonna in General Surgery,"* RICHARD H. HARTE, M.D., Demonstrator of Osteology and Syndesmology, University of Pennsylvania; Surgeon to the Episcopal and St. Mary's Hospital; Consulting Surgeon to St. Timothy's Hospital.
- "Local Therapeutics of Belladonna in Diseases of the Skin,"* ARTHUR VAN HARLINGEN, M.D., Prof. of Diseases of the Skin in the Philadelphia Polyclinic and College for Graduates in Medicine; late Clinical Lecturer on Dermatology in Jefferson Medical College; Dermatologist in the Howard Hospital.
- "Local Therapeutics of Belladonna in Diseases of the Ear, Nose and Throat,"* HARRISON ALLEN, M.D., Consulting Physician to the Rush Hospital for Consumption; late Surgeon to the Philadelphia and St. Joseph's Hospitals.
- "Local Therapeutics of Belladonna in Diseases of the Eye,"* GEORGE C. HARLAN, M.D., Surgeon to Will's Eye Hospital, and to the Eye and Ear Department of the Pennsylvania Hospital; Emeritus Professor of Diseases of the Eye, Philadelphia Polyclinic, etc.
- "Belladonna Plasters in Diseases of the Skin," JOHN V. SHOEMAKER, A.M., M.D., Prof. of Materia Medica, Pharmacology, Therapeutics and Clinical Medicine, and Clinical Prof. of Diseases of the Skin in the Medico-Chirurgical College of Philadelphia; Physician to the Medico-Chirurgical Hospital, etc., etc.
- "Applying Belladonna Plasters," notes and suggestions, A. H. LAIDLAW, M.D., New York.
- FRED. B. KILMER, Ph.C., editorial compilation, and articles on**
"Belladonna in Pharmacy," "Dispensing Plasters."

Special Translations.

- Extracts from lecture on "Emplastra," Prof. Doc. RUDOLPH KOBART, Director Pharmacologischer Institute Zu Dorpat.
- "Conclusions on Physiological Action of Belladonna," "Cultivation of Belladonna in France," translated from A. DORDELU, *Recherches sur quelques points de "l'action de la Belladonne,"* Paris, 1879.
- "Belladonna Plaster in Vomiting," GUÉNEAU DE MUSSY, translated from *Transactions Société de Therapeutique,* Paris, 1887.
- "The Action of Belladonna," ANDRE ISADORE MEURIOT, translated from "De la Methode Physiologique et de ses Applications a l'etude de la Belladonne," Paris, 1869.
- "Names and Synonyms," PETRUS JOANNIS DARIES, translated from thesis "De Atropa Belladonna," Leipsig, 1776.

Special Abstracts.

- Notes, "Belladonna Leaves of the Market," "Belladonna Root of the Market," E. R. SQUIBB, M.D., abstract from *Ephemeris*, Vol. ii.
- "Belladonna Locally as an Anti-Galactagogue," M. W. LEAVITT, M.D., abstract from *Massachusetts Medical Journal*.
- Therapeutic Index; Notes compiled from Leading Therapeutic Authorities.

* By special permission from "Local Hand-Book of Therapeutics," P. Blakiston, Son & Co., Philadelphia, Pa.

Belladonna Pharmacognosy.

Historical

Belladonna is recorded as native in both Greece and Italy, and was doubtless known to and described by the ancient Greek and Roman writers. According to Fraas (Synop. Plant. Fl. Class p. 166, 1845) the Mandragora of Theophrastus, the Stryknos manikos (anthos melan) of Dioscorides, and the third sort of Strychnos (Solanum) of Pliny, all refer to the medicinal belladonna of to-day.

In military operations frequent use was made of the properties of belladonna.

Henry Kraemer, Ph.G.

EDITOR,

Department Pharmacognosy,
Reporter Progress of Pharmacy
American Pharmaceutical Association.

Sauvages says that belladonna produced strange and dreadful effects upon the Roman soldiers during their retreat (under command of Anthony) from the Parthians. They are said to have "suffered great distress for want of provisions and were urged to eat unknown plants; he that had eaten of it lost his memory and his senses, and employed himself in turning about all the stones that he could find, and after vomiting up

bile fell down dead." (Plutarch's life of Anthony.) Cæsar, when encamped in the Pyrenees in an unfavorable position, made use of a similar root to keep his army from starvation.

Rudolph Camerar records a stratagem of some soldiers who took a bottle of wine, poisoned with the root of belladonna, near to the camp of the enemy, pretending that they were on their way to their own army with a purchased or stolen treasure. The enemy fell upon these men, plundered them of their goods and hastily drank all of the wine. The first effect was a deep stupor, whereupon the few who had brought the wine as messengers of Atropos, fell upon them, cut the thread of life and sent them to their everlasting sleep. Shakespeare is believed to refer to the root when he makes Banquo ask:

"Or have we eaten of the insane root
That takes the reason prisoner?"

Ainslie (Mat. Ind. 1,240) states that belladonna was well known to the Arabians and Persians, but that he has never met with it in India. Theophrastus and others have spoken of the poisonous properties of the Mandragora. The true Mandragora, though quite different in appearance, is very similar in its action to belladonna. It was called mandrake and employed anciently by pretending magicians and false sorcerers to produce mental hallucinations. Buchanus (Rerum Scot. History, 162) says "that the destruction of the Danish army under Sweno, when he invaded Scotland, was due to the intoxicating qualities of the berries of this plant which the Scots mixed with the drink they were obliged to furnish the invaders. While the Danish soldiers lay under its soporific influence the Scotch fell upon and destroyed them.

Saladanus of Ascoli (Comp. Arom. 1488) makes the earliest reference to belladonna among writers on medicinal plants. According to Flückiger and Hanbury, the first certain reference is in the Grand Herbier printed at Paris about 1504. The plant is mentioned (Solatrum mortale or Dolwurtz) in the writings of Hieronymus Brunschwyg (1515). Reference is made by Tragus (Historia) under the name Solanum hortense nigrum. In 1542 belladonna was figured as Solanum somniferum or dollkraut by the German botanist, Leonard Fuchs. This, in brief, is the history of belladonna as handed down by many different writers on subjects of natural history and materia medica. The closer we observe the gradual growth into prominence and usefulness of our most valuable and powerful medicines, we find this gradual evolution repeated. First, the experiment with them by force of circumstances without any knowledge; then the trial by men who supposed that they knew how to use them; and finally, as a result of this experience, comes the true knowledge of physicians and pharmacists who are able to use them judiciously and properly compound them.

Names and Synonyms.

Atropa Belladonna.—*Linne.* Natural order Solanaceae.

Synonyms.	English:	{ Dwale.
		{ Deadly night-shade; black cherry, night shade.
	German:	{ Tollkraut, dollkraut, dollwurtz,
		{ Tollkirsche, Wolfskirsche.
		{ Tollkirschen-Wurzel, Tollkirsche, Wolfskirchen-wurzel.
	Italian:	Belladonna.
	Spanish:	Belladonna; Belladama.

Names and Synonyms with Authorities for Use of Same.

From Inaugural Thesis, "Petrus Joannis Daries, De Atropa Belladonna," Leipzig, 1776.

Atropa Belladonna—*Linn.*
 Solanum Melanocerasum—*Bauh.*
 Belladonna—*Tournef., Clus., Matthioli, Tragi, Dioscorid., Raii.*
 Atropa—*Royen.*
 Solanum furiosum—*Camerar., Letale, Lobel, Dodon, Clutii, Thalii.*

Solanum Maniacum multis, Belladonna—*i. b.*

Solanum bacca nigra serasi simili—*Tabern.*

Solanum cosmeticam—*Weimann, Hoffman, Opsago, Gerard, Pulchra.*

Mulier, Tournef.

German:	{	Schlafbeere, Irrbeere, Marien	raut, Tollwurtz, Schweinrotl,
		Wuthbeere, Willbeere, Wi	beere, Wald nachschatten, Toll-
		beere, Walkenbaum, To	
		felsbeere, Weidbeere.	
English:		Dwale, Deadly, raging or	
French:		Morelle, Marine, Bellad	

Italian :	Solatro, Maggiore, Belladonna.
Belgian :	Groote Nachshaad oft Dulcruyt Dulle Besien.
Spanish :	Yerva, Mora Major.
Lusitanis :	Ayura, Erya Mora.
Bohemian :	Lilek Wetsy, Psy Wino.
Polish :	Pfinki, Moszenky, Pfie Wisnie, Michnonky.
Hungarian :	Zepzolo.
Danish :	Natskade, Sovv Boer, Swineurz.

The name "Atropa" is from *Atropos*, one of the Parcae, daughter of Nox and Erebus. Her duty among her three sisters was to cut the thread of life without any regard to sex, age or condition, so it was supposed that the one who partook of this plant would be cut off in the race of life.

Derivation of Name Belladonna.

"The name belladonna was applied in Italy to the plant now generally known under this name. When the word first came into use cannot now be ascertained, but the second part of the compound 'donna,' from the Latin '*domina*,' shows that it must have been in use before the end of the tenth century. The origin of popular names of plants is in the majority of cases enveloped in darkness; many of them no doubt take their origin from superstitious fancies, imaginary healing powers, or accidental causes. 'Eye-bright' (*Euphrasia officinalis* L.), is an instance of this kind; yet there is no doubt that its name correctly represents the belief once entertained in its virtues of curing sore eyes and making them bright.

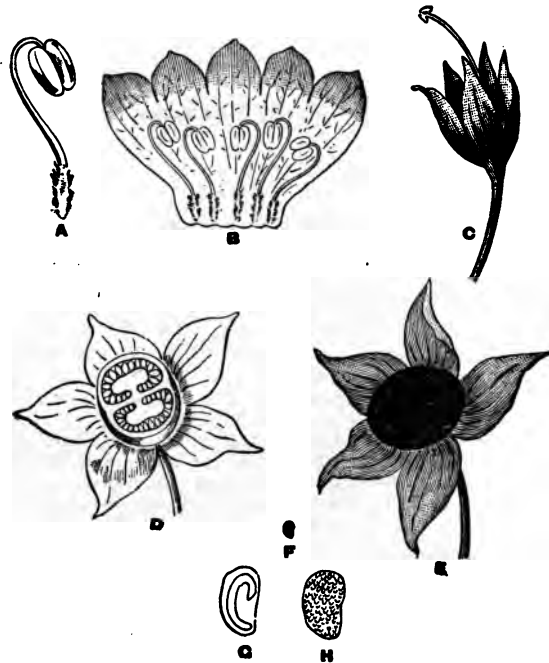
Note by
Chas. Rice, Ph.D.,
Chemist Dep't of Public Charities and Corrections, New York; Chairman Committee of Revision and Publication Pharmacopœia of United States, 1880-1890.

Authorities differ as to the locality where the term 'belladonna' was first used.

Matthioli (in his *Commentarii in Dioscoridem* lib. iv, 5) states that the plant called mandragora by Theophrastus was that to which the herbalists then gave the name Solatrum majus, and which Venetians called 'Bella donna.' Anguillara, (in his *Semplici*, 8° *Vinegia*, p. 90), states that the name 'Bella donna' is given to the plant in the vicinity of Padua, while it is called 'Fava inversa' elsewhere. Some authors say that the name arose from the fact that the Italian women used the juice of the plant or a water distilled (?) from certain parts of it, as a face-wash to give them a pale complexion, it being at that time considered unfashionable to possess florid, red cheeks. (See *Mangetus Biblioth. Pharmaceutico Med.* ii, 867.) Others again (E. Hamilton in *Flora Homœop.* iii, 64, authority not quoted,) state that it was so named because it had been used by Leucota, a famous Italian poisoner, for 'killing beautiful women.' Many assert that some preparation of the plant was used by Italian ladies to enlarge the pupils of their eyes, so as to give them a more bewitching effect. All these explanations must remain in doubt, as there are no means of verifying them."

The name "Belladonna" has also been applied to the belladonna lily (*Amaryllis belladonna*) on account of its great beauty and blushing appearance. Thomas Hare (1816) used this synonym also for a variety of rose, described by him as being a highly colored belladonna or Maiden's Blush rose. The name "night-shade" is used as a synonym for the *Solanum nigrum* of the United States.

Description.*



BELLADONNA.

- A. Stamen.
- B. Corolla lobes, spread open showing insertion of stamens.
- C. Calyx with slightly exserted style.
- D. Calyx adherent to berry. The latter cut showing the seeds.
- E. Berry and adherent calyx.
- F. Seed cut showing curved embryo.
- G. Seed, externally fitted.
- H. Seed, natural size.

Belladonna is a large, bushy, strong growing annual herb, from 3 to 5 feet high. [See plate, page 11.]

Stem erect, thick, cylindrical, smooth or slightly downy with a tinge of red or purple; at first dividing into three, the branches are dichotomous and frequently branching, the youngest shoots being pubescent.

Leaves numerous, alternate below, in pairs above of unequal size, all shortly stalked, 3 to 9 inches long, broadly ovate, or oval, tapering into the petiole, acute, perfectly entire, dark green and veiny. They possess a heavy, mawkish smell.

* (Bentley and Trimen, iii, 193)
 (Griffith's Med. Bot., 846)
 (Med. Botany, Woodville, 230)
 (H. Karsten's Deutsche Flora, 969)
 (Abbild u Bes. Aller. Pharm. Borus Gew., p. 16, illus-8)

Flowers are solitary, drooping (rarely 2 or 3 together) on short axillary peduncles, the latter as long or longer than the calyx with short glandular hairs.

The calyx is green, persistent and deeply divided into five triangular- acuminate segments.

The corolla is gamopetalous, campanulate with the limb divided into five broad, shallow, blunt, nearly equal, spreading or slightly recurved, lobes of a lurid purple, darker in the upper internal surface, yellowish below.

The stamens 5, inserted on the base of the corolla and shorter than it; filament curved upwards at the end, anthers four-lobed small roundish (or caudate) yellowish white.

The ovary is spheroidal with a nectariferous gland beneath and supporting a long, simple and slightly exserted style; stigma green and two-lobed.

The fruit a fleshy berry, sub-globular, depressed, umbilicate at the summit, very obscurely two-lobed about $\frac{3}{4}$ of an inch in diameter, deep purple black, smooth shining, surrounded at base by the enlarged persistent calyx, two-celled, fruit stalk erect. Taste sweetish, and instances are recorded of fatal results from its being sold in London for blackberries.

Seeds numerous, crowded slightly, attached to the axile placentas, rounded or oval or faintly kidney shaped, about 1-6 of an inch in diameter, minutely pitted and reticulated, embryo curved on itself in the endosperm.

Habitat :

Belladonna is native of Central and Southern Europe and found in hedges and waste places, especially among ruins and near towns. It is found in Germany, Switzerland, France, Italy, Spain, Sicily, Hungary, extending to the Crimea, Caucasia, and North Asia Minor.* It does not extend farther north than Denmark.

The map shows in an approximate manner in the shaded portions the principal points of supply of the commercial varieties. The towns indicated are the principal centres of exportation of the root and leaves to the United States.

At one time Belladonna was so luxuriant in the vicinity of Furness Abbey that the immediate neighborhood was known as the "vale of nightshade." It is cultivated for medicinal use in Central and Southern Europe, England, but not in North America, although attempts have been made to establish it as a drug in this country.

*Bentley and Trimen, (Medicinal Plants, Vol. 3, 193, 1880) and other authorities, say belladonna is cultivated in North America. This seems to be an error as diligent inquiry by the editor revealed the fact that probably not as much as a hundred pounds has ever been gathered of the wild or cultivated plant in the United States. Specimens at present cannot be found in the Botanical Gardens. In the Botanical Gardens at Washington it was stated that they had abandoned the growing of belladonna owing to the danger of keeping such a highly poisonous plant. Serious accidents having resulted from visitors picking the attractive but deadly flowers and berries. (Kilmer.)

The plant known as the deadly nightshade with indigenous root-diggers in America, is *Solanum nigrum*, a common weed around door yards and rubbish. (J. U. Lloyd.) *Atropa Belladonna* has never been naturalized in North America; the "nightshades" are, however, often reported as the true drug, and are known in many parts where indigenous as "belladonna." (Maisch.)

Cultivation and Collection.

In Lincolnshire, belladonna is propagated by the seeds. They are removed from the berries, then washed and planted in the fall. The plant comes up the



MAP OF EUROPE SHOWING, IN SHADED PORTIONS, HABITAT AND PRINCIPAL SOURCE OF SUPPLY OF BELLADONNA.

following spring and when of sufficient size is picked out. The following year it is fit for cultivating. The first crop of leaves is collected in the beginning of July, and the second crop about the first week in September. As the plants grow larger each year their weight tends to split the root, causing water to get into it and producing decay, so that cultivation can rarely be continued beyond the third year in the same field. When this occurs, the land is ploughed and selection is made of the root, and all that is in good condition is dried and sold.

In Cambridgeshire, the seed is drilled in during spring. The ground is chalky and admirably suited to the growth of belladonna. The soil at Lincolnshire is not so well suited to the development of the plant on account of the total absence in some places, or of the small quantity, of lime present in the soil. At Cambridgeshire the drainage is also assisted by the porosity of the soil, but the plantations are exposed to the full east winds and the late spring frosts are apt to injure the plant as it is then only a foot or more high. There is also a green fly, which in some seasons (about the beginning of June) attacks the leaves, causing them to pucker and wither. (See note, page 11.)



BELLADONNA, FLOWERING SPECIMEN AND ROOT.—[SEE PAGE 8.]

NOTE ON INSECTS ATTACKING BELLADONNA PLANTS, by Prof. C. V. Riley, Entomologist
Department of Agriculture, Washington, D. C.

"Three species of insects are enumerated in Kaltenbach's 'Pflanzenpeinde' as enemies of the belladonna plant, but this work has not been brought up to date, and there are probably several other species which attack it. The three species in question are as follows:

Haltica pubescens of which *H. atropi* is a synonym. This a small species of Flea-beetle which occurs also on other species of Solanaceous plants. It gnaws the leaves, eating out little pits and riddling them with holes. It occurs on the plant before it blossoms, usually frequenting the underside of the lower leaves. The larvae are unknown.

The second species is *Agrotis baja*. This insect is also found on the primrose and strawberry, the moth appearing in July.

The third insect is *Agrotis candelisequa*. The hibernating larva occurs in spring upon belladonna and also upon Goldenrod. It transforms in May and is seen as a moth in June. Both the last mentioned insects belong to the family Noctuidae, or Owlet Moths. These species are all European and are unknown in this country."

The plant is cut about the end of June. For making the leaf extract the leaves are not dried, but the green plant is sold and used at once. The best crop of leaves are yielded by the plants of the second and third year. The leaves of the first year are not fit to cut, and as they dig up the roots during the fourth year, there are practically only three years during which the plants yield a crop. There is a record of wild belladonna having reached a height of six feet in a very poor limestone soil which, however, was incapable of producing cultivated crops. Before the time of flowering the plants are not rich in active principle, but at the period of flowering the full development is reached and maintained. At Hitchin the plants are propagated by seed and by divisions of the roots. The annual crop is said to vary from one to five tons per acre.

Where the plant has not reached too great a size it is simply mowed with a scythe and is dried with attached stems and stalks, but in this process other plants are cut down and mixed with it. In the fancy brands, the leaves are carefully picked from the stems, and dried on cloth or wire trays, using at first a low heat which is gradually increased. This is said to preserve the natural color. Persons employed in gathering the plant have their eyes much affected by the belladonna.

In England, immediately after collection, the leaves are placed in a closed drying closet containing a large number of sliding trays, (the heat being furnished by steam pipes) a draught of fresh air entering below and the heated moist air escaping from above. In this manner they are speedily dried without access of light.

"The Belladonna plant is generally found in the centre of France upon the mountains, walls and ruins. It prefers damp, shady places, underbrush and dark woods. When grown in such places its medicinal properties are much greater than when it grows in the sun and is cultivated.

In gathering, soilage and season must be taken into consideration. The properties are more active when wild grown.

It has half as much more alkaloids when two or three years old than at seven or eight years.

In France foliage and roots are not gathered at the same time.

In preparing the best grades of dry leaves for market or use, the best looking plants are selected, the leaves cut or broken off and carried to a granary or loft and dried upon screens. There they are frequently raked over or pitched and turned to prevent sweating and spoiling. They are dried until they crumble. Care must be employed that too rapid or too long drying does not destroy the green color. The roots are gathered by digging with a fork. They are washed, split, partially dried in a drying box, and finally dried fully and quickly in an oven."

Note by

A. Dordelu,

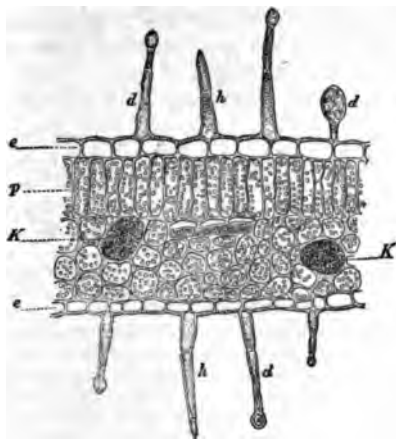
From thesis: "Recherches sur quelques points de l'action de la Belladone," Paris, 1879.
(Translated for this Work.)

Belladonna Leaves.

Macroscopically.

Belladonna leaves are of two sizes, the larger about $1\frac{1}{2}$ d. m. long, the smaller being about $\frac{1}{2}$ this size. They are brownish-green upon the upper surface and

gray-green below, broadly ovate or ovate-long, narrowed into a petiole; apex, acute or acuminate; margin entire, the petiole and nerves of the underside of the leaf particularly are downy, hairy and glandulous. Both surfaces of the leaf possess trichomes, numerous cells are apparent, filled with crystal-like contents, giving the leaf the peculiar spotted appearance it possesses. The leaf is membranaceous, odor narcotic and taste bitter and disagreeable.



I. CROSS SECTION OF LEAF.

- e. Epidermis (upper surface).
- e. Epidermis (under surface).

p. Palisade cells under which are the mesophyll cells.

- k. Crystal containing cells (Calcium oxalate in minute crystals.)
- t. Simple trichome.
- t. Head bearing and gland bearing trichome.

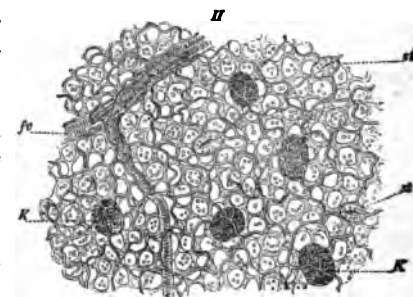
containing an innumerable number of granule-like or crystal-like bodies.

Belladonna Leaves of the Market.

As found in the market, belladonna leaves, especially the finer grades, when crumpled or broken up, looks very much like the mints, but are easily distinguished from them by the narcotic odor and disagreeable bitter taste. They also resemble somewhat the narcotic herbs, stramonium and hyoscyamus, but from these may be easily distinguished.

Belladonna leaves compared to the other officinal leaves of the Solanaceæ are comparatively smooth and the margin is entire. The upper surface is darker than the lower surface. The undeveloped fruit, a calyx with an unripe berry, is often present.

Stramonium leaves are dark green and not quite so smooth as belladonna, the hairs shorter, with a many celled apex, and in the mesophyll are numerous cells containing large single crystals of calcium oxalate. The perforations and cork formations in the leaves are numerous. The base of the leaf is unequal and does not taper into a petiole. The fruit is a capsule and very often a few reuniform seeds will be found present.



II. SURFACE SECTION OF LEAF.

- st. Stoma.
- fb. Fibro-vascular bundle (spiral vessels).
- k. Cells containing crystals.

Hyoscyamus leaves are furnished with long hairs which tend to become tangled and matted, so giving the leaf a hairy appearance. There is an absence of petiole and a presence of stem stalks. The fruit is a pyxis enclosed in an urn shaped calyx. The seeds are much smaller than stramonium.

Solanum nigrum leaves are much smaller than belladonna with a repand dentate margin. (Wigand.)

"The description of the pharmacopœia applies accurately to a very few leaves that could be picked out of a bale of belladonna; these would have to be carefully moistened and spread out for examination, all the rest of the bale having to pass unrecognized, being simply a mass of crushed and broken leaves and stems, of a more or less uniform character and color.

Note on Belladonna Leaves of
the Market, by

E. R. Squibb, M.D.,

Ephemeris, Vol. II, 848.

When the prevailing color is fairly uniform, and fairly green—not brown—when the appearance and odor are free from mustiness, and without signs of previous dampness and fermentation, when free from admixture with dissimilar leaves or parts of leaves, as digitalis, hyoscyamus, weeds, etc., and when seed capsules with ripe seeds are found, the parcel may be accepted as fair quality, and gathered at the proper time. If the leaves appear to have been all

very large, and are very green, and no capsules to be found, somewhat like the fancy leaves sold in bottles, at high prices, this is a sign of cultivated plants harvested when the leaves are most succulent, but not most active. Though very attractive and handsome *such leaves are less active than the wild plants taken at maturity.* When a careful buyer is shown various samples of belladonna not a word of the official description is of any avail to him and he only knows that what is before him is belladonna from having seen it more or less frequently, and the grades of quality are also wholly judged by an experience which can hardly be conveyed by any description. But belladonna is frequently seen with a very considerable admixture of other plants, recognized and unrecognized, as though whole patches of ground had been mowed where Belladonna was simply the prevailing production. These low, cheap grades are generally sold for powdering, and then all discrimination is at an end, because all the landmarks of character and quality are gone.

A very small number of those who know belladonna, a still smaller number of those who make preparations from it—and none of those who either prescribe or take it—ever see it in the leaf, in bales as it comes from abroad. The importing jobber, or the wholesale druggist, imports it and has it powdered, and the pharmacist or physician simply buys the powder."

Belladonna Root.

Macroscopic Characters.

The root of belladonna is a fleshy, spindle-shaped primary root. When fresh it is about 5 d. m. long and about 5 c. m. in diameter. It then possesses a number of stout branches, the remnants of which are sometimes seen attached to pieces of commercial root. The bark contains the largest amount of alkaloid, therefore roots are selected by careful buyers which possess the larger portion of bark compared to the woody portion.* Young roots of but two or three years are preferred. Chemical analysis shows that the amount of alkaloid in roots collected

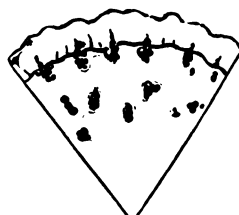
* Woody fibre predominates in old roots as well as in some fairly young specimens grown in certain localities. Roots which are woody, tough and break with a splintery fracture, as well as hollow stem bases, should be rejected in selecting for pharmaceutical preparations.

Very little alkaloid can be found, except in the bark, in woody specimens; the woody portions have been reported as yielding no alkaloid whatever. (Maisch).

about the time of flowering is twice as much as in spring, so roots should be collected about the flowering and fruiting season, carefully dried and preserved.

The commercial root, to hasten the drying, is invariably split into smaller pieces. It occurs in rough, irregular pieces from a few inches in length to 6, 8 or even 12 and 15 inches, varying in diameter according as the root is split. Externally it is longitudinally wrinkled, of a pale brown or grayish color, internally brownish or whitish, odor heavy and licorice like, taste peculiar, characteristic, sweet at first and afterwards acrid or bitter. The fracture may be mealy, horn-like or woody, and from these characters may be distinguished three commercial varieties.*

(1.) **Mealy Belladonna.**—Is lighter externally and internally than the other two, and on cross sections it is of a nearly uniform dirty white appearance. The bark is about $\frac{1}{4}$ of the cross section. At the periphery of the fundamental tissue of the pith are yellowish vascular bundles scattered apparently indiscriminately. These finally disappear beyond the cambium. Starch is present throughout all the cells of the wood and bark, which is colored blue by Iodine. In spring and autumn roots, the starch is present in the largest amount.



MEALY BELLADONNA ROOT CROSS SECTION.



HORN-LIKE BELLADONNA ROOT CROSS SECTION.

(2.) **Horn-Like Belladonna.**—Is very dark. On cross section it looks brownish and waxy, or horn-like. The bark is separated by an indistinct cambium from the woody portion, of which the fibro-vascular bundles are arranged in single groups and separated from each other by one or more broad bands of a horn-like tissue. (Keratenchym.) In the tissue of both the wood and bark occur numerous cells filled with crystal-like contents appearing to the eye as white spots. This variety looks more like inula root, and is much smaller generally than the other two. The starch grains are replaced by a dark, resinous material,

(3) **Woody Belladonna.**—This form possesses characters between the other two. The color is more of a light brown or gray. In cross section the bark resembles the horn-like variety. Inside of the cambium ring is found a prominent, radiating, woody zone with the largest duct in the very centre. The wood bundles have prominent yellow ducts and are separated by equally prominent broad medullary rays. This variety is generally figured in text books. Starch grains are not so numerous as in the mealy variety, still they are abundant.



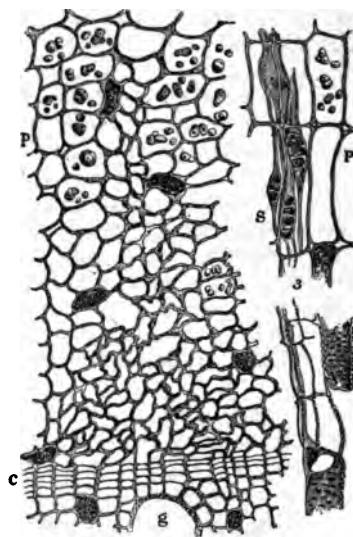
WOODY BELLADONNA CROSS SECTION.

Microscopically.

The cork consists of thin layer of cells, next to which is arranged the cortex. In the latter are numerous cells filled with crystal-like particles, called by Wigand *krystalmehl*, and by Moeller

* Works consulted: { Lehrbuch der Pharmakognosie von A. Wigand.
Anatomischer Atlas zur Pharmakognosie von A. E. Vogel.
Pharmacognostischer Atlas von J. Moeller.
Traité Pratique de la Détermination des Drogues.
Simples par G. Planchon.

krystalsand. These are very common characteristics in both the roots and the leaves of belladonna. The sieve tubes are scarcely perceptible in the bark of young roots, but later are formed in groups more or less wedge-shaped like the wood bundles. These sieve tubes show a beautiful sieve plate in longitudinal section. Stone cells are wanting. As regards the bast in Belladonna authors disagree.* Wigand (4th edition, 1887,) mentions the presence of bast. Prof. Schrenck announced in the *American Druggist*, (1887, 2) that he had detected bast cells in belladonna root, but found it necessary to remove the starch and stain the cells. The writer examined a mount made by Prof. Schrenck from the belladonna root of commerce, (Oct. 16, 1886) mounted in glycerine jelly, and stained apparently with phloroglucin, and readily made out bast cells. Upon further investigation he found it unnecessary to use clearing and staining agents to discover them. The ducts are provided with elliptical pores. The wood bundles are surrounded by wood parenchyma, (colored yellow by potassium hydroxide solution) the bundles separated from each other by radially broad medullary rays. Both the wood and bast parenchyma contain starch. The starch grains are of medium size, in shape round, irregular or hemispherical, or even two or three sided; single and sometimes compounded of two or four starch grains. Some of the grains possess a distinct cross cleft or a stone-like nucleus; in others, however, the stratifications are scarcely apparent. With sulphuric acid alone large numbers of prismatic crystals are produced. With sulphuric acid and bichromate of potassium a greenish coloration is immediately produced, remaining sometimes twenty-four hours or more. This will be a help in determining this root.



1. Cross Section of Root.
- p. Rind-parenchyma with starch and crystal cells.
- c. Cambium with a cuneated sieve-tube.
- g. Xylem portion (duct).
2. Radial Longitudinal Section of Root.
- p. Rind-parenchyma.
- s. Sieve tube showing plates.
3. Tangential Section, showing wood parenchyma and ducts.

The Starch of Belladonna Root.

Starch is by far the most abundant and universally distributed of non-proteid reserve food materials found in plants, and it always exists in the form of corpuscles or granules. These appear to be composed of two substances: granulo-se, which constitutes by far the large part of the grain (90 to 95 per cent. of its weight), and a skeleton composed of farinose or starch cellulose.

In structure the starch grain is not of equal density throughout. Every starch grain has a hilum or nuclear portion around which the rest of the grain has been

* Authorities have heretofore described the atropa belladonna root as free from bast fibres. If upon careful investigation it is found that bast fibres are sufficiently defined to be a characteristic feature, text-books should hereafter record the fact. (Maisch).

deposited in layers, and the hilum and layers next to it are less dense than those farther exterior. The hilum may be located centrally in the grain.

Note by

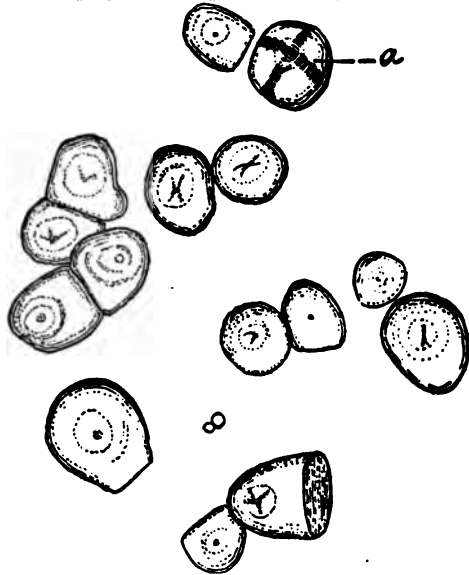
Edson S. Bastin,

Professor of Botany and Pharmacognosy in the Philadelphia College of Pharmacy.

which then usually has a rounded form, or it may be located to one side of the centre, in which case the form is apt to be elongated. Moreover, different layers of the grain contain usually different proportions of water, for which reason there is often appearance of concentric or eccentric lines or curves about the nucleus.

Starch grains, in nearly all cases, if not in all, are formed by the agency of proteid bodies, either chloroplasts or amyloplasts.

That formed in chloroplasts under the action of the sunlight, is gradually dissolved and transferred as glucose or some other soluble carbo-hydrate to some other part of the plant, where it is either employed in the processes of growth or else is stored again, usually in the form of starch, for future use. It is this, the reserve starch, which forms the conspicuous grains that are the subject of our present study. These are formed by amyloplasts, partly at least, at the expense of the amyloplast itself, and partly, according to the investigations of A. Meyer and M. E. Laurent, not only from glucose and cane sugar, but out of various other carbo-hydrates or bodies related to them, such, for example, as mannite. Strasburger holds, and apparently with good reason, that in rare instances starch is formed from the general protoplasm of the cell, and not solely from amyloplasts, and some have maintained that it is occasionally formed by mere crystallization in the cell, without the aid of any proteid whatsoever; but this certainly remains to be demonstrated.



STARCH GRAINS FROM BELLADONNA ROOT.

a. Is grain as seen by polarized light.

The figure shows a group of starch grains from the root of belladonna. The grains may be described as spherical, prolately spheroidal, or not infrequently double or hemispheroidal.

The hilum is in central or somewhat eccentric, and marked either by a small dark, or by a faint, radiating or darkish lines. Concentric circular lines about hilum few and indistinct.

Belladonna Root of the Market.

Belladonna root is much the more important part of the belladonna plant; first, because it is much the strongest or most active part; second, because it is

most uniform in strength ; third, because it is less liable to be contaminated with parts of other plants ; fourth, because it is most easily dried without injury, and less liable to injuries by dampness, etc., in transportation and keeping, and fifth because it keeps better and longer without deterioration. In short, it has the advantage over the leaves in all the most important qualities proper to medicinal substances. The root is commonly bought and sold in powder, and very few pharmacists or physicians ever see it except in cabinets or museums. These selected specimens tend more to mislead than instruct ; because, as a rule, such specimens are never seen in any considerable quantity in commerce.

Note by

Dr. E. R. Squibb,

Ephemeris, Vol. II., 853.

The powder is of a dirty, whitish color, and everything else being equal, the whiter and handsomer it is, the poorer. Old, discolored and damaged root is not very infrequently "brought up" in color in the grinding process, and would not be salable if this could not be done, since it would not be handsome enough.

The roots though originally cylindrical are generally split to facilitate drying. At least, all the larger ones are split in the best parcels of the drug. They are somewhat wrinkled longitudinally, but perhaps more wrinkled transversely, and most of the markings are tranverse. The fracture is squarely tranverse, but not smooth, and the exposed structure is spongy; the spaces radiating from the centre.

The peeled root is commonly preferred in the market and commands a higher price ; but it has been repeatedly shown that the fashion of peeled root is kept up by the sale of the peelings to the makers of atropine. At least, if the root be judged as it is met with in the market, the peelings would yield more alkaloid than the entire root, and considerably more than the peeled root.*

Worm Eaten Belladonna.

In common with many other vegetable and animal drugs belladonna in a dry state is attacked by insects. Large lots are sometimes put upon the market well riddled by the pests. They usually find their way to the drug mill where root borings, excrement and debris are ground to powder. In the shops in loose parcels, packages or drawers, and even in shelf bottles, the drug rarely escapes their ravages.

The insect is the *Lasioderma serricorne*, and belongs to the beetles, or Coleoptera, of the family *Ptinidae*.

Note on The Insect Attacking
Belladonna Root, by

Prof. John B. Smith,

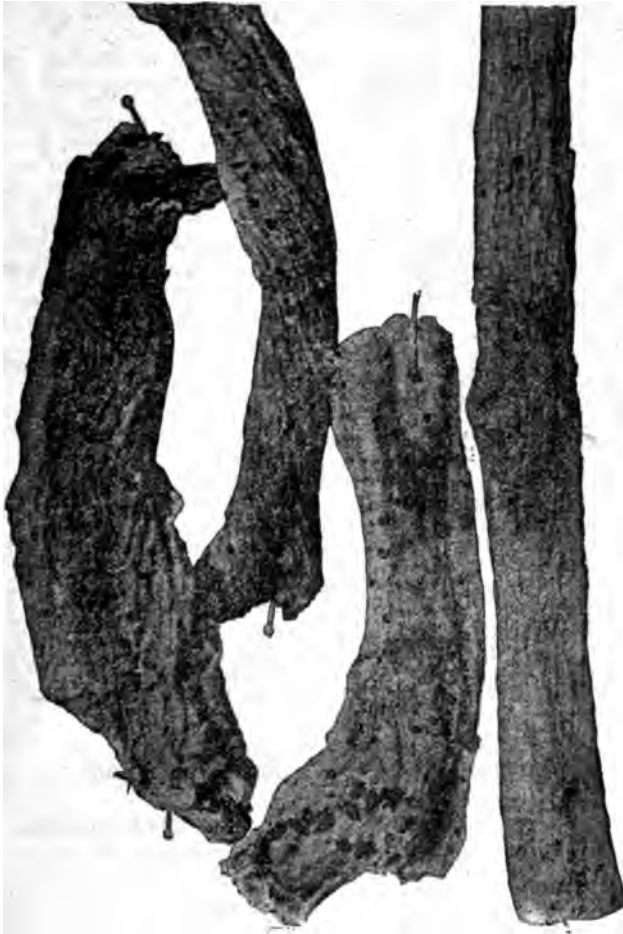
Entomologist, New Jersey
Agricultural Experiment Sta-
tion. Prof. Entomology,
Rutger's College.

In this family we find a large number of species that feed both as larvae and as adults on dead and dry vegetable matter of the most diverse description, and among them are certain forms that become decidedly injurious to stored and even manufactured products. The species under consideration is the most troublesome, and it is almost omnivorous. It is known to attack many sorts of drugs of vegetable origin, and their poisonous qualities do not deter or injure it. It attacks tobacco, and under the term "tobacco beetle" is a serious pest in many manufactories and warehouses. It breeds in plug tobacco, in cigars, and even in cigarettes, and in

working out makes holes through the wrappers of the cigars and cigarettes that spoils them for smoking.

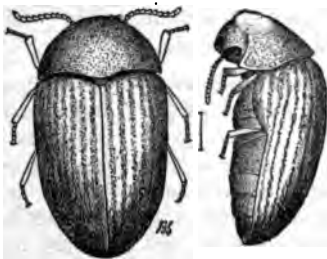
* Peeled belladonna is not so frequently met with in American markets as formerly, though specimens of the powdered root have been seen which under the microscope showed almost entire bark structure. (Maisch).

The insects breed all the year around if the temperature is moderately warm,



WORM EATEN BELLADONNA ROOT.

and the injury increases constantly.



LASIODERMA SERRICORNE.

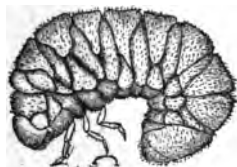
The beetle is of a pale chestnut brown color, less than an eighth of an inch in length and rather broad and robust; somewhat ovate in form. Eggs are laid on or in the material to be fed upon, and from these, which are small, ovate and white, a little, white, footless grub hatches in about one week. These grubs or larvae increase in size rapidly, becoming rather more than an eighth of an inch in length fat and clumsy, resembling on a small scale those found in nuts and acorns. In from two to three weeks they are full grown, change to a pupa, and shortly after to the beetle.

The injury to roots, leaves, or other tissue is caused by both larva and adult, both of which

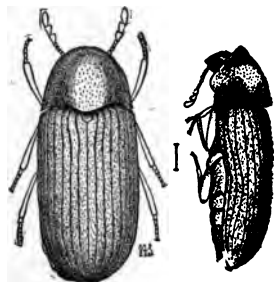
are voracious feeders. The substances are consumed, a large proportion assimilated, and, of course, completely changed, while the balance becomes frass, or excrement, to which, whatever of the original active principle it may yet contain, is added some secretion of the insect which makes it unfit for use, and unreliable.

Roots and herbs attacked by this insect should be carefully freed from all the dust and fragments produced by the insects before being used. The insects succumb readily and in all stages to gasoline, and to its vapor, in tight receptacles, in all save the egg state. The vapor of carbon disulphide also kills the larvae and beetles; but not the eggs. Napthaline checks development and thus prevents injury; but except in tight receptacles, does not kill. To prevent injury the materials should be stored in clean glass or tin receptacles, for the insects can and do bore through wood, and even sheet lead.

Another insect also belonging to the same family Ptinidae, and with much the same habits as the preceding, is *Sitodrepa panicea*. This is somewhat smaller and more slender than the *Lasioderma* though of the same general color. The two insects are quite readily distinguished not only in size, but by the fact that the *Lasioderma* has the wing covers smooth and clothed with very fine hairs in rows, while in the *Sitodrepa* the wing covers are striated or furrowed and also clothed with hair. The difference in the appearance is very well shown by the figures. So far as the habits of this insect are concerned, they are very much like what has already been described, and the insect feeds on very much the same materials in very much the same manner. The larvae of the two species are also very similar in appearance, and the figure which represents that of the present species will answer almost as well for that of the *Lasioderma*. The two species sometime occur together infesting the same material; but more frequently one species will be found alone. The suggestions as to the prevention of injury which are previously given will apply equally well here.



SITODREPA PANICEA, LARVA.



SITODREPA PANICEA.

Adulterations or Admixtures of Root.



JAPANESE BELLADONNA ROOT WITH SECTION. THE FIGURE ON THE RIGHT IS OF TRUE BELLADONNA SHOWN FOR COMPARISON.

Japanese Belladonna (*Scopolia Japonica*, Maximowicz) is a rhizome from 5 to 10 d. m. in length, and on an average 1 d. m. in diameter, cylindrical, slightly compressed, rarely branched or knotty; on the upper surface, marked by circular slightly alternate stem scars. Externally brown, internally paler, speckled with numerous white dots, odor mousy and narcotic.

Scopolia Carniolica Jacquin is obtained from Bavaria, Austro-Hungary and South-western Russia. The genus *Scopolia* is interesting as it forms a connecting link between *hyoscyamus* and *atropa*.

Scopolia is a rhizome and resembles the genus *Atropa* in containing peculiar crystal-like contents; but they are less

prominent. Neither the bark nor the fibro-vascular bundles are so large or so numerous. The starch grains are likewise smaller. There is a close alliance in the anatomy of these two plants, but all of the important characters are less pronounced than in belladonna. *Belladonna scopolia* is also a rhizome, and, like Japanese belladonna, may be distinguished from true belladonna, which is a root. This root is substituted by manufacturers for *Atropa belladonna*, as it gives a large yield of extract. Where a preparation claims to represent the pharmacopoeia, which explicitly calls for the use of true belladonna, this course is of doubtful propriety.

Messrs. W. H. Cole & Co., Drug Merchants, London, make the statement that "*Scopolia Carniolica* is always picked and rejected as useless by makers of atropine."

Elecampane (*Inula Helenium, Linne*) is the root of *Inula*. This root possesses resin cells, the taste is aromatic, and it is stained yellow by iodine—being free from starch.

Medicago Root (*Medicago Sativa, Linne*) has been noticed as an adulterant in Europe. It is distinguished from belladonna by a solid crown; the bark is thinner, and the medullium is tough and woody and traversed by numerous fine medullary rays.



MEDICAGO SATIVA WITH SECTION.

Marshmallow (*Althea officinalis, Linne*), is said to be used as an adulterant for belladonna. It resembles the young uncoated root. It is easily distinguished by its radiating wood, numerous bast fibres and mucilage.*

Lappa (*Arctium Lappa, Linne*) root is sometimes admixed with belladonna. It is distinguished by its peculiar pith, its distinct radiating bark and being colored yellow by iodine and blue by ferric chloride.



SCOPOLIA CARNIOLICA.

Constituents.

Galen is the first author who refers unquestionably to the mydriatic action of two species of Solanaceæ. Dr. Ray, in 1686, reported the case of a lady who had placed a belladonna leaf upon a small ulcer beneath the eye and afterwards was annoyed by an excessive dilatation of the pupil. Evers independently in 1773 discovered the mydriatic power of belladonna. These writers were followed by Davies (1775) and Loder (1796). After this, the specific action of belladonna upon the eye be-

* Holmes noted that belladonna root of the market had been found to contain as high as 50 per cent. marshmallow root *Malva Sylvestris*. It has been stated that some time ago the herbalists in Madrid offered for sale as belladonna a plant which was not belladonna, nor even belonging to the order Solanaceæ. It was called in the Madrid market "*Belladonna Silvestre de la casco de campo ares botanica cucubalus*." (A. P. A. Vol. 21.)

came generally accepted. Runge in 1819 approximately isolated the alkaloid of hyoscyamus and called it koromegyn (meaning magnifier of pupil). In 1830 the apothecary Mein isolated the alkaloid atropine from the root. Independently Geiger and Hesse in 1832 isolated the crystallized alkaloid from the herb, while Liebig in 1833 determined its chemical formula. No recent complete analysis seems to have been made.

The following table is compiled from those considered authoritative. It should be noted, however, that some of the conclusions have been questioned : *

Constituents of Belladonna.—

$C_{17}H_{23}NO_3$	Atropine.
$C_{17}H_{23}NO_3$	Hyoscyamine.
$C_{17}H_{21}NO_4$	Belladonnine (Hubschmann) base and sulphate amorphous.
$C_{17}H_{21}NO_2$	Atropamine (O. Hesse) by action of H Cl. is converted into Belladonnine.
	Apoatropine (Pesci) first obtained by action of nitric acid upon Atropine (probably identical with Atropamine).
	Starch both free and combined with potassium salts.
	Malic acid. (This acid is mentioned as the acid of belladonna which combines with bases forming natural salts.)
$C_{12}H_{17}O_6$	Chryastropic acid (Kunz) concentrated solutions show green and blue fluorescence.
$C_{17}H_{23}O_6$	Leaxtropic acid (Kunz) from mother liquors.
	Succinic acid (Kunz) from extract of herb.
	Acetic acid (Brandt).
	Prendatorin (Brandt) with oxalate and sulphate of calcium.
	Phyteumscolla.
	Gum, wax, mucilage, asparigin, albumin.
	Atrosin coloring principle of root.
	Chlorophyll coloring principle of leaves.
	Potassium sulphate, Nitrate, Phosphate, Chloride, Hydrochlorate, Oxalate and Malate
	Magnesium Malate and Phosphate.
	Calcium Malate and Oxalate.
	Sodium Phosphate.
	Ammonium salts.

The Production of Atropine in the Plant.

Messrs. Schering in 1888 stated that belladonna roots contain practically only hyoscyamine, and that atropine was a decomposition product produced during the process of manufacture. Drs. Will and Schmidt (1887) proved that the mere con-

* The full constituents of belladonna have not been accurately determined by modern authorities ; investigators, in recent years, have given more attention to some one or more special constituents.

The constituents of the root may be approximately given as alkaloids 0.2 to 0.6 per cent., belladonnine (probably oxyatropine $C_{17}H_{23}NO_4$) hyoscyamine, atropamine, starch, atrosin. The leaves contain about 0.5 per cent. mydriatic alkaloids, choline (bilineurine), mucilage, wax, asparagin, albumin, chrysastropic acid (scopletin), succinic acid, malic acid (?) nitrates, ash 1.4 per cent. Hyoscyamine is the predominating alkaloid of the leaves. (Maisch.)

It is not generally admitted that malic acid is combined with atropia in belladonna. Prof. Flückiger does not mention it in his latest work, *Die Pharmakognosie des Pflanzenreichs*, 1890, and he has suggested the possibility of its being some other acid. My own conclusions are that, although it is not proven that atropine is united to malic acid in belladonna root, one would have the majority of evidence on his side if he considered the combination to be atropine malate. (Dohme).

tact of an alkali with hyoscyamine was sufficient to produce this change. Dr. Schutte (Arch. der Pharm. 1891, 492) found that the same result is produced by repeated crystallization from acidulated water. He also investigated the influence that age and period of vegetation exerted upon alkaloids in the roots, leaves and berries. He found that fresh roots (one to two years old) collected from a basaltic district, whether gathered in the spring, summer or autumn, contained only hyoscyamine, but the older roots (8 years and upwards) always contained besides much hyoscyamine a little already formed atropine. Similar results were obtained with roots from old cultivated plants that had been kept for several years. Spring and autumn leaves of belladonna contained principally hyoscyamine, with equal quantities of ready formed atropine. The unripe berries of the wild plant contained chiefly hyoscyamine and a little atropine, but the ripe fruit contained only atropine. The ripe berries of cultivated plants, however, yielded both hyoscyamine and atropine. His investigations upon other members of the Solanaceæ indicated that hyoscyamine is the primary base from which other alkaloida products may be formed.

The Relation of Atropine and Starch.

Buddel (Arch. der Pharm., 1882, 414) found the starchy roots to contain from .41 to 1 per cent. of alkaloid, while the non-starchy yielded from .143 to .625 per cent. This would seem to indicate that besides the physical tests and the ease with which the test of starch may be applied that the microscopical examination of specimens for starch will have considerable weight in determining the alkaloidal value of the root. Brandes has stated that the quantity of starch present is dependent upon the period of vegetation. Brandes also found young roots to contain less starch in spring than in autumn, and older roots are rich in starch in both spring and autumn, but contain less in summer. This may be explained by the fact that the young plant is more active and ambitious to obtain its full growth and uses up nearly all the nourishment provided by its parent. The next year, having its growth, it is more moderate in its use of its storehouse, and also manufactures in addition a nitrogenous substance in the nature of atropine. This new substance is produced in greater amount the next year, when it reaches its maximum development. Buddel says that the proportion of alkaloid in a root will increase year by year up to a certain point. This probably is a providence on the part of the plant; similarly as some of the plants in arid and desert regions produce cathartic or other harmful principles to prevent the animals from eating them, and so destroying them from the face of the earth. Plants of the second or third year, gathered late in the summer when the flowers have begun to fade and the roots possess the largest amount of starch, are selected as containing the maximum amount of atropine.

Dealers in belladonna root select the heavy and compact varieties in preference to the woody and lighter specimens as they require less space in storing and less menstruum in preparation. It is also conceded that they will give the larger yield of alkaloid.

Conclusions.

Regarding the time of collecting and variation of alkaloid in the plant, investigators have drawn the following conclusions :

The first year's growth of belladonna contains but one-half the quantity of atropine present in older plants, and so are unworthy of collection.* From the second to the fourth year the quantity of alkaloid is fairly uniform. At these ages and during the period of flowering the plants should be collected. The plant before flowering is not rich in active principle, but at the period of flowering the full development is reached and maintained, both in roots and leaves. (Gerard.) Wild grown belladonna contains a larger quantity of alkaloid than the cultivated kind. The process of flowering and leafing does not exhaust the roots of its alkaloid, there being a simultaneous development in the root and leaf ; therefore the roots may be gathered at the same time as the leaf.

Gerrard's analysis of the freshly gathered plant shows the highest percentage of alkaloid in the leaves ; following them the root, fruit and stem, and the wild plant contains the largest amounts of alkaloids. Later investigators, however, have shown that the root will show a much higher average. The results of analysis of the commercial dry root and leaf of belladonna indicate that the roots yield a much higher percentage of alkaloid than the leaves. (.82 per cent. has been found.) A chalky soil favors the formation of atropine, which may account to some extent for the superiority of the English leaf. Belladonna leaves in pressed packages several years old, do not show evidence of loss of alkaloids. (Lyons.) Both the root and leaf of belladonna shows great variations in strength, and, as has been said, appearance alone is not a sufficient criterion as to the relative value of one lot as compared with another. The peculiar acid and acrid taste of belladonna, which is more apparent as the sense of taste is cultivated, together with general physical characters already described, are fair indications to an expert of the value of a sample of belladonna. Chemical analysis is however the only certain and reliable test as to the full value.

* Young roots contain only hyoscyamine. The older roots contain both hyoscyamine and atropine, the latter predominating. In young leaves atropine is present but hyoscyamine is the predominating alkaloid. The length of keeping after gathering appears to have no influence on the alkaloid present, (Maisch.)



Belladonna in Pharmacy.

By
Fred. B. Kilmer, Ph.C.

This drug has held a prominent place in the formularies from very early times. The subjoined list shows the parts of the plant now recognized in the various pharmacopœias.

PHARMACOPŒIA.	PARTS USED.
United States, 1880.....	Leaves and root.
" " 1890.....	" " "
British, 1890.....	" " "
Codex Medicamentarius.....	Leaves, root and seeds.
Germanica.....	Leaves.
Belgica.....	Leaves and root.
Neerlandica.....	Leaves, root and seeds.
Helvetica.....	Leaves and root.
Rossica.....	Leaves, root and seeds.
Norvegica.....	Leaves.
Fennica.....	Leaves and root.
Austrica.....	" " "
Hungarica.....	Leaves, root and seeds.
Sueica.....	" " "
Espanola.....	" " "
Mexicana.....	Leaves.
Italian.....	Leaves and root.
Portuguese.....	" " "
Saxony.....	" " "
Bavarian.....	" " "
Holland.....	" " "
Hamburg.....	" " "
Prussian.....	" " "
Hanover.....	" " "
Wurtemberg.....	" " "

Miscellaneous Preparations.

Belladonna has for so long received attention in medicine that merely a list of the various forms in which it has been prepared would be very lengthy. The first methods in use were the expression of the juice of the green plant (and root); this was sometimes extracted with water or wine.

Infusions of belladonna, made by boiling belladonna root or leaves in water, are still official in the French, Swedish, Russian and other pharmacopœias. In the Spanish Ph. cold water is used. The formula of the Wurtemberg Pharmacopœia (1795) for a vinegar of belladonna, made by maceration of the root in vinegar with some added alcohol for preservation, is still in use. A formula from the same source, used somewhat in France and Germany, is for honey or syrup made by boiling with vinegar, to which honey is added to the consistency of a syrup.

Syrups of belladonna are official in the French Codex, Belgium Pharmacopœia, and are used in many countries; they are usually prepared by extraction with alcohol and mixing with syrup.

The ancient Duval water still survives in aqua belladonna (Belgian Ph.), a distillate from a mixture of fresh leaves and water.

The tinctures of belladonna of most formularies are made from the leaves by maceration and percolation with alcohol. The Austrian Ph. directs the use of the root. The French codex and Belgian Ph. have an ethereal tincture made by extracting the leaves with ether.

The oil of belladonna made by boiling fresh belladonna leaves with olive oil (French Codex, Hamb. Ph. 1835, Belgian Pharm. 1853) is in use.

The fixed oil of belladonna expressed from the seeds has been used in medicine as a liniment and also for cooking and illumination. The U. S. P. and Br. P. have liniments of belladonna into which camphor enters.

Ointments of belladonna of various strength, but similiar in mode of preparation to that of the U. S. P., are common to many formularies. A poultice of belladonna (Spanish and Mexican Ph.) is made of powdered leaves and linseed meal.

The extracts of belladonna both solid and fluid have commanded the greater attention in the pharmacopœias. The older methods were simply an evaporation of the fresh juice of the plant or leaves to the consistency of honey. With some modifications this is the process of the British, Greek, Spanish, Neth. Ph. and the French Codex. (The plant yields in June about 36 per cent. by weight of juice). As an improvement, the extraction of the inspissated juice with alcohol, or a mixture of alcohol and water, was substituted.

The solid extract of the root in the U. S., British and Austrian Ph., and the French Codex is made by extraction with alcohol and subsequent evaporation to the consistency of an extract. (The French Codex formerly directed the use of the seeds.)

The abstract of belladonna is peculiar to the U. S. P., 1880, although powdered extracts of the leaves and root combined with milk, sugar or licorice is found in several formularies; also several glyceroles combining the extract with glycerole of starch.

Belladonna as treated in the last two editions of the United States Pharmacopœia is shown in the following articles:

Official Preparations, United States Pharmacopœia, 1880.

<p>By Joseph P. Remington, PH.M., F.C.S., Prof. of Theory and Practice of Pharmacy, and Director of the Pharmaceutical Laboratory in the Philadelphia College of Pharmacy; First Vice-Chairman on the Committee of Revision and Publication of the Pharmacopœia of the United States of America; Pharmaceutical Editor of the United States Dispensatory, etc., etc. By special permission from "The Practice of Pharmacy."</p>	<p>LEAVES. <i>Belladonnæ Folia.</i></p>	<p>Made with belladonna leaves and a menstruum of two parts of alcohol and one part of water, five per cent. of glycerine being incorporated with the finished extract. Dose, one-fourth of a grain.</p>
	<p>Extractum Belladonnæ Alcoholicum. Alcoholic Extract of Belladonna.</p>	
	<p>Tincture Belladonnæ. Tincture of Belladonna.</p>	<p>Made by percolating fifteen parts of belladonna (leaves) with sufficient diluted alcohol to make one hundred parts. Dose, ten to twenty minims.</p>

LEAVES.

entum Belladonnæ.....Made by rubbing ten parts of alcoholic extract of belladonna with six parts of diluted alcohol and incorporating eighty-four parts of benzoinated lard.

ROOT.

Belladonæ Radix.

actum Belladonnæ.....Made by adding an evaporated alcoholic fluid extract of belladonna root to sugar of milk, so that one grain represents two grains of belladonna root. Dose, one-half to one grain.

ctum Belladonnæ Fluidum. ...Made from belladonna root with alcohol. Extract of Belladonna. Dose, one to twenty minims.

strum Belladonnæ Made by incorporating extract of belladonna onna Plaster. root with resin plaster.

entum Belladonnæ.....Made by dissolving five parts of camphor in onna Liniment. ninety-five parts of fluid extract of belladonna.

Atropina, U. S. ; Atropine (Atropia, Pharm. 1870), $C_{17}H_{23}NO_3$; 289.

Dose, one one-hundred-and-twentieth to one-sixtieth of a grain.

ATROPINA, U. S.	ODOR, TASTE AND REACTION.	SOLUBILITY.		
		WATER.	ALCOHOL.	OTHER SOLVENTS.
colorless or white, acicular crystals, permanent in the air. heated to 114° C. (237.2° F.) the crystals melt, and, on cooling, are completely dissolved, emitting acrid vapors. The free base and its salts are deliquescent and rendered inert on prolonged contact with potassium carbonate or soda, and, if heated with either of them, evolve ammonia.	Odorless ; bitter and acrid taste ; alkaline reaction.	Cold, 600 parts. Boiling, 35 parts.	Very soluble.	Soluble in 3 parts of chloroform and 60 parts of ether.

TESTS FOR IDENTITY.

With sulphuric acid Atropine yields a colorless solution, which is neither precipitated by nitric acid (difference from morphine) nor at once by solution of potassium permanganate (difference from strychnine) though the latter reagent on prolonged contact causes the solution to turn green. On heating this green solution, diluted with a little water, to boiling, a pleasant odor recalling that of mandarin orange-flowers is developed. The aqueous solution of Atropine, or of its salts, is not precipitated by test-solution of platinic chloride (difference from most other alkaloids). With chloride of gold it yields a precipitate, which re-crystallized from boiling water, acidulated with hydrochloric acid, is deposited on cooling (rendering the liquid turbid) in minute crystals, forming a colorless powder on drying (difference from hyoscyamine.)

Atropinæ Sulphas, U. S. Sulphate of Atropine. $(C_{17}H_{23}NO_3)_2H_2SO_4$; 676.
(Atropæ Sulphas, Pharm. 1870.)

ATROPINÆ SULPHAS, U. S.	ODOR, TASTE, AND REACTION.	SOLUBILITY.		
		WATER.	ALCOHOL.	OTHER SOLVENTS.
A white, indistinctly crystalline powder, permanent in the air. When heated on platinum foil, the salt is decomposed and wholly dissipated, emitting acrid vapors.	Odorless, very bitter, nauseating taste; neutral reaction.	Cold, 0.4 part. Boiling. Very soluble.	Cold, 6.5 parts. Boiling, very soluble.	0.3 part of absolute alcohol.

TESTS FOR IDENTITY.

On adding test-solution of carbonate of sodium to a concentrated aqueous solution of the salt, a white precipitate is obtained which answers to the reactions of Atropine. An aqueous solution of the salt yields with test-solution of chloride of barium a white precipitate insoluble in hydrochloric acid.

Belladonna in the New Pharmacopœia.

Atropa Belladonna L., its preparations and products; as treated by the new Pharmacopœia differs but slightly from that of the edition of 1880. A glance at the following lists of titles will show what has been dropped and also make apparent the changes in names.

1880.
Abstractum Belladonnæ.
Atropina.
Atropinæ Sulphas.
Belladonnæ Folia.
Belladonnæ Radix.
Emplastrum Belladonnæ.
Extractum Belladonnæ Alcoholicum.

Extractum Belladonnæ Fluidum.
Linimentum Belladonnæ.
Tinctura Belladonnæ.
Unguentum Belladonnæ.

1890.
Atropina.
Atropinæ Sulphas.
Belladonnæ Folia.
Belladonnæ Radix.
Emplastrum Belladonnæ.
Extractum Belladonnæ Foliorum Alcoholicum.
Extractum Belladonnæ Radicis Fluidum.
Linimentum Belladonnæ.
Tinctura Belladonnæ Foliorum.
Unguentum Belladonnæ.

Additions and subtractions have been rather unimportant. The abstracts, first introduced experimentally, failing to gain popular favor, are now abandoned. Abstract of belladonna, of course, had to go with the rest. A possible new preparation might be introduced by any pharmacist under the title Tincturæ Herbarium Recentium as it gives authority for one of fresh belladonna herb. A suggestion was made to introduce hydrobromate of atropine but it was not done.

Atropine has been altered in its molecular weight, the formula of the old chemistry has been omitted and its description and tests materially changed. The weight that was formerly given as 289 is now placed at 288.38. This is due to the use of the most recently corrected atomic weights in which oxygen is given as 15.96

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instead of 16, carbon as 11.97 instead of 12, and nitrogen as 14.01 instead of 14. Hydrogen being the standard of reference is held at one. The formula of atropine being $C_{17}H_{23}NO_4$, we have $17 \times 11.97 + 23 + 14.01 + (15.96 \times 4) = 88.38$.

While the old text told us that atropine was prepared from belladonna and gave no hint of the fact that it is seldom or never found pure, the new says that it is obtained from that drug and is always accompanied with more or less hyoscyamine from which it cannot be easily separated. Instead of being told as before that it is permanent in the air, we now learn that it gradually assumes a yellow tint on exposure to the air. Its solubility, which as given in the old is 600 parts of cold water and 35 parts of boiling water, very soluble in alcohol, soluble in 3 parts of chloroform and 60 parts of ether, is now set down as 130 parts of cold water, 3 of alcohol, 16 of ether, 4 of chloroform and about 50 of glycerine. It is now said to melt at 108°C . instead of 114°C .* and we are told that it gives off acrid fumes at 140°C . Its marked alkaline reaction is emphasized by the statement that its saturated aqueous solutions become pink with phenol-phthalein and under certain conditions give a yellow precipitate with corrosive sublimate, that soon turns red.

Sulphate of atropine has also been altered in its molecular weight and has had its old formula of the old chemistry changed. The molecular weight of 676 has now been replaced by 674.58. A glance at the formula, $(C_{17}H_{23}NO_4)_2H_2SO_4$, shows it to be made up of two molecules of atropine and one of sulphuric acid. Sulphur having had its atomic weight changed from 32 to 31.98 takes part in altering the molecular weight of the sulphate. The new weight of sulphuric acid is $2 \times 31.98 \times (15.96 \times 4) = 97.82$. If now we add 97.82 to twice 288.38 we will get 674.58 which is the new figure for atropine sulphate. The solubility as given by the old text agrees with the new for water and is very nearly the same for alcohol. It does not, however, give the figure for absolute alcohol and states it for ether to be 2.270 parts and for chloroform 694 parts. It is now said to melt into a brownish liquid at 187°C . and to be neutral to litmus paper. In other particulars the two texts agree.

Belladonna leaves in the Pharmacopœia of 1880 were described as to length, but the width and surface appearance were forgotten. Now we are told that besides being from 10 to 15 centimeters long they are also from 5 to 10 centimeters wide and that both surfaces are whitish punctate. It was hoped and expected by many that a minimum alkaloidal standard would be fixed for both leaves and root, but the sub-committee having this in charge deemed it the wiser part not to multiply such innovations too rapidly. Ultra critics may be inclined to charge against them the fact that they do not mention the age of the plant nor season of collecting the leaves, forgetting that foreign collectors are not readers of our Pharmacopœia and are in no way controlled by it. Those familiar with the subject tell us that they should only be collected during the flowering season of the second year's growth.

Belladonna root, as now described, does not vary a great deal from the 1880 text. The minimum thickness of the pieces is placed at 10 instead of 12 millimeters; they should not radiate or show medullary layers in the thicker roots, but only in the layer near the bark and we are told to reject the hollow stem-bases which are

* This change in the melting point of atropine seems to have been adopted after careful consideration by the revisers, and is presumed to be correct for atropine as found in American markets. It is probable that for various reasons the exact melting point of C. P. atropine has not been determined. The following are the melting points as given by different authorities: 114°C , Ladenburg; U. S. P. 1880, Watts, Thorp; 114.5° to 115°C , Dohme; 115.5°C , Schmidt; 107 – 109°C , Eccles, Merck, (109); 104°C , Squibb, (completely melted 113); the difference may be partly accounted for by the fact that the atropine used by the different observers was not of the same degree of purity. The lower figures presumably being the nearer pure. (Kilmer)

sometimes present. If it had been an American crop, the harvesting of which could have been controlled by us, roots of the first year's growth should alone have been made officinal. Two year old roots have been examined that contained no atropine. The range of alkaloid in various samples varied very widely. It is common to find roots on the market ranging from 1-5 to $\frac{3}{4}$ of one per cent. Had the committee seen fit to standardize it, about $\frac{1}{2}$ of one per cent. would have been a good average.

Belladonna plaster has now to be made from the alcoholic extract of belladonna leaves instead of from the root as formerly. In the 1880 edition a lengthy description of how to percolate and exhaust the powdered root used in making the plaster was given under this head. This being omitted in the new edition neither alcohol nor belladonna root appear in the formula, but as a new addition thereto we find soap plaster. As both resin and soap plasters contain in their composition lead plaster, it should here be mentioned that this last substance is now ordered to be washed free from glycerine. Formerly no such directions were given although in practice manufacturers usually did so. The following sample formula from the new edition of the Pharmacopœia, for emplastrum belladonna, will show the reader the style of type and the new method of giving weights and measures according to the metric system.

[Sample type and formula from the new Pharmacopœia.]

EMPLASTRUM BELLADONNÆ.

BELLADONNA PLASTER.

Alcoholic Extract of Belladonna, <i>two hundred grammes</i>	200 Gm.
Resin Plaster, <i>four hundred grammes</i>	400 Gm.
Soap Plaster, <i>four hundred grammes</i>	400 Gm.

To make *one thousand grammes* 1000 Gm.

Melt the Plasters on a water-bath ; then add the Extract of Belladonna, and continue the heat, stirring constantly, until a homogeneous mass results.

The principal reasons that influenced the revisers in selecting alcoholic extract of belladonna leaves instead of the specially prepared extract of the root for making belladonna plaster were the facts that there is greater uniformity of the quantity of alkaloid present in the extract of the leaves than in that from the roots; and if the retail pharmacist should occasionally be required to make a plaster of this kind the work would be far less for him by the new than by the old method.

Alcoholic extract of belladonna leaves in the Pharmacopœia of 1880, did not have the word leaves attached. The formula there given was longer than the new by the addition of dilute alcohol and glycerine. Then one hundred parts of the leaves were ordered ; now it is one thousand grammes. The percolation is now accomplished with a menstruum composed of two volumes of alcohol to one of water, instead of two parts by weight of alcohol to one of water, and the drug is exhausted with this single menstruum instead of finishing with dilute alcohol as formerly. Glycerine is not now ordered to be added, but the preface to the volume mentions the fact that those who wish to keep any solid extract may add glycerine thereto. The change in menstruum alters to a trifling extent the proportions of

and alcohol soluble constituents.

Fluid extract of belladonna root was originally fluid extract of belladonna, the word root not appearing in the title. Instead of being percolated with straight alcohol as a menstruum it is now exhausted with one composed of 4-5 alcohol and 1-5 water. This change was made for the purpose of securing a product with the least tendency to precipitate on standing and with the highest per cent. of alkaloid compatible with this condition. A large number of experiments were made with different tinctures and fluid extracts for the purpose of accurately determining these points.

Belladonna liniment of 1880 differs from that of the new Pharmacopœia in that both the camphor and fluid extract were weighed in the former, while only the camphor is weighed in the latter, and the fluid extract is added up to the required amount. This makes the new preparation contain a trifle more camphor than the old. The difference is so slight, however, that no one is likely to observe it.

Tincture of belladonna leaves has been changed so little it is in this respect scarcely worth consideration. The word leaves has been added to the title, 100 parts by weight have been altered to 1,000 grammes for the leaves and to 1,000 cubic centimeters for the finished product. This makes 6.67 cubic centimeters of the new tincture represent one gramme, while about 7 cubic centimeters was the equivalent in 1880.

Belladonna ointment is prepared from the same ingredients as in 1880, but the proportions are very slightly altered. The word grammes appears in place of parts. The benzoinated lard is changed from 86 parts to 85 grammes, and the diluted alcohol from 6 parts to 5 grammes.

A New Series of Reactions for Atropine.

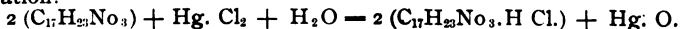
As used in the Pharmaceutical Laboratory of the University of Strassburg.

Atropine.— $C_{17}H_{23}NO_3$. Melts in boiling water. Melting point, 115° C.

a. Soluble in ether, alcohol, chloroform and slightly in carbon bisulphide. Aqueous solutions of atropine turn red litmus paper blue and redden phenolphthalein paper.

b. 1 milligramme of atropine dissolved in 1 C.c. of alcohol and heated with 1 C.c.

of a solution of mercuric chloride (1 part in water 19 parts) on a water-bath, will cause a precipitate of yellow mercuric oxide to be formed; not, however, if the atropine is added last. The reaction taking place is represented by the following equation:



c. Mercurio-potassium iodide containing (Hg. I_2 45.4 gms.) in one liter and mercurio-potassium bromide, containing :

(Hg. Br. 36.0 gms.)
(K Br. 23.6 gms.) in one liter give precipitates with solutions of atropine, which soon become crystalline.

d. A solution of tannic acid (1 part in water 19 parts) gives a precipitate with atropine solutions, soluble in excess of the precipitant or in acetic acid.

e. A solution of potassium bichromate (1 part in water 19 parts) causes no precipitate, and a saturated aqueous solution of picric acid causes a precipitate only in hot saturated solutions of the alkaloid.

f. 0.1 gramme of atropine, when boiled with 3 C.c. of water and 0.2 gramme of mercurous chloride, causes the latter to turn black; on filtering the boiling

Contributed by

Alfred R. L. Dohme.

alkaline liquid and supersaturating this, after cooling, with dilute nitric acid, there will be formed a considerable precipitate on the addition of silver nitrate solution.

g. By heating about one milligramme of atropine in a glass tube until white fumes begin to form, then adding 1 C.c. of sulphuric acid, spec. grav. 1.840, again heating until the mass begins to turn brown, then carefully adding 2 C.c. of water, drop by drop, a very pleasant odor is developed. This is very easily destroyed if only a trace of potassium bichromate or permanganate be present before the addition of the water.

h. By heating 1 C.c. of glacial acetic acid with 1 C.c. of hydrochloric acid, spec. grav., 1.124 and 1 milligm. of atropine, the mixture will become fluorescent, the color being greenish yellow. The pleasant odor mentioned under *g.* can also be detected in this case.

i. Rub together on a porcelain plate 1 milligm. of atropine and 1 milligm. of sodium nitrate and make a paste of this by adding to it one drop of sulphuric acid, spec. grav., 1.840. Now add to this some solid caustic potash and moisten the mass with a few drops of alcohol; a beautiful violet color will be produced.

Extraction of Belladonna.

Alcohol is the proper menstruum to use for the abstraction of belladonna. The addition of water increases the amount of extractive matter derived from both

the root and the leaves without, however, causing a corresponding increase of alkaloid. Hence, an aqueous extract in excess of that which may be obtained with alcohol from the same drug is likely to be decreased in value.

The application of heat sufficient to distill the alcohol from a small amount of

an alcoholic percolate does not disintegrate the natural alkaloidal combination, but leaves the resultant soft extract possessed of the full physiological energies of the original solution. The admixture of free acids or alkalies, especially alkalies preceding evaporation, is likely to prove injurious. Aqueous extracts should not be exposed to continued high temperatures; they deteriorate under such condition even if free mineral acid be present, hence aqueous extracts are from this cause also likely to be inferior to alcoholic.

The most eligible and reliable belladonna preparation of an extractive consistence is the alcoholic semi-solid extract made by quick evaporation of small amounts of percolate. If the vacuum concentration is used, larger batches can be worked to advantage than by direct evaporation.

Neither solution of atropine nor of the salts of atropine or hyoscyamine in proportion to correspond to those obtained from the alcoholic extract or tincture of belladonna seem to possess the full qualities of the alcoholic extract or a percolate of good belladonna. Hence admixtures of extractive with the purified alkaloids cannot fully replace natural belladonna extractives that are of the same alkaloidal proportions.

For this reason, phyto-chemical analysis does not altogether determine the comparative therapeutic value or physiological energies of belladonna preparations, although it may be safely accepted that such preparations as are deficient in alkaloid are correspondingly inferior.

Note by

John Uri Lloyd,

Prof. of Pharmacy, Cincinnati
College of Pharmacy.

Johnson's Perfect Mustard Plaster



They are stronger than others and will keep much bet



Canthos Painless-Quick

An improved Cantharidal Plaster U.S.

COMPARATIVE TESTS.

Can	U.S.P. CANTHARIDAL CERATE	FRENCH Blister Plaster	RUBBER Blister Plas
	TIME	TIME	TIME

...PHILADELPHIA VERY KINDLY PERMITTING US TO SAY TO PHYSICIANS AND DRUGGISTS THAT "HE IS GREATLY PLEASED WITH **JOHNSON'S BELLADONNA PLASTER** THAT IT GIVES QUICKER AND BETTER EFFECT THAN ANY BELLADONNA PLASTER HE HAS HERETOFORE USED.



Johnson's Belladonna Plaster

has met with approval.

An Improvement has been made in the addition of Boracic acid to the Plaster base with a view of opening the skin pores and enabling the drug to be absorbed.

Belladonna Plaster Formulas.

In many ancient authoritative formulas, Belladonna Plasters were made by boiling the juice of the plant with an equal weight of linseed oil and adding yellow wax and Venice turpentine to the proper consistency.

The following table gives the formulas now in use in the various countries named, as authorized by the Pharmacopœias.

PHARMACOPŒIA.	PREPARATION.	BASE.
United States, 1880.....	Extract Belladonna Root....	Resin Plaster.
United States, 1890.....	Extract Belladonna Leaves..	Resin Plaster.
		Soap Plaster.
British.....	Extract Belladonna Root....	Resin Plaster.
		Soap Plaster.
French Codex....	Extract Belladonna Root....	Gum Elemi and Diachylon Plaster.
German.....	Extract Leaves	Olive Oil, Turpentine, Yellow Wax.
Belgian ..	Extract Leaves.....	Olive Oil, Burgundy Pitch Plaster.
		Yellow Wax, Lead Plaster, Olive Oil, Turpentine.
Netherland.....	Extract Leaves.....	Yellow Wax, Colophony, Olive Oil, Turpentine.
Helvetian.....	Extract Leaves	Yellow Wax, Colophony, Lead Plaster, Olive Oil, Turpentine.
Russian.....	Powdered Leaves	Lead Plaster.
Mexican.....	Extract Leaves....	Resin Elemi, White Wax.
Italian.....	Extract Leaves.....	Burgundy Pitch, Elemi Resin.
Spanish.....	Oil of leaf; (leaf boiled with olive oil.)	Lead Plaster.
Portugal.....	Extract Leaf.....	Yellow Wax, Colophony, Olive Oil.
Hamburg.....	Powdered Leaf	Resin, Olive Oil, Yellow Wax.
Hanover.....	Powdered Leaf.....	Resin, Yellow Wax, Olive Oil.
Wurtemberg, 1847	Powdered Root.....	

Belladonna Plaster.—Johnson & Johnson's Formula.

Belladonna Root

assaying 5-10 per cent. alkaloids—one hundred parts.

Extracted with alcohol by macero-percolation; reduced in vacuo to a semi-solid extract.

Incorporated by mixing cold with

Plaster Mass	<div style="display: inline-block; vertical-align: middle;"> <div style="font-size: 3em; vertical-align: middle; margin-right: 5px;">{</div> <div style="display: inline-block; vertical-align: middle;"> Caoutchouc, Olibanum, Picis Burgundica, Oleum Olivæ, Cera Flava, Gum Resin Galbanum, Boric Acid, </div> </div>	} To make 100 parts finished plaster.
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Making Belladonna Plasters.

Plasters are such common articles of merchandise that we are apt to think of them as things that are bought and sold by the pound or yard ; but, in the com-

pounding and mixing room, problems arise that call for the same judgment and skill needed in all branches of scientific pharmacy.

The physician demands a plaster that will act as a curative agent ; if it will not do this he prefers some other mode of treatment.

To suit his ideas a plaster must be:

"Thin, flexible, strong." "Firmly adhesive; but not too much so." "Properly mixed; spread evenly to give accurate dosage." "A mass that is adhesive and waterproof." "That will allow drugs therein to act." "That will aid absorption." "Of standard, accurate strength."

The patient will tell you that he does not put on plasters for fun, or as a substitute for clothing ; he wants to get well. The patient wants a plaster that is:

"A cleanly and convenient application." "Simply to apply and take off." "Cheap and efficient."

The dispenser wishes all they ask for, and besides :

"Good looks." "Plasters that will not change." "Not affected by age or climate." "Easy and simple to dispense." "Attractive and perfect packing." "Efficient in action." "Affording a fair profit."

These are all legitimate demands. It would be impossible to fulfil them, and use the bases and methods of the Pharmacopœias ; however, it may be done and still retain the officinal standard of medicinal strength.

To make a good belladonna plaster with any kind of a base, is not easy. It was not accomplished in the "good old way," when belladonna juice or the leaf itself was "melted down" with lead and resin. The heat used in these processes is very destructive.

The National Dispensatory says "temperature 120-130 is required." In my experience this heat would greatly injure belladonna, would be disastrous, and good belladonna would be cremated in the mass so that it would never reach the spot where it could do any good as a curative.

The plaster-maker has to carefully consider not only the drug, as in the case of belladonna, but every separate ingredient, every step of the process, the effect of every combination, and to follow it out to its ultimate application.

Everything put into a plaster which is not an active medicinal agent, or has no use in promoting adhesion or absorption, is simply debris that will fill the pores of the skin with so much dirt, and stands in the way of the drugs being absorbed.

All sorts of powders and fillers are used to make a thick, hard mass that will "look and keep," but the effect is to hold the belladonna in the plaster, and not let it reach the skin. The proper selection of belladonna root, the proper handling of belladonna root, the proper extraction of the active principles and the proper preparation for combination with the plaster mass are four equally important factors in the making of a perfect belladonna plaster.

The alkaloids of belladonna are easily broken up and destroyed. The efficiency of the plaster greatly depends upon the condition in which its active ingredients are held. To act promptly and give the best results the ingredients must be in a soluble form, and in a state to readily pass through the skin. A very hard, insoluble, old or imperfect extract of belladonna is useless in a plaster. I have known plaster spreaders, who, in order to get a nice looking plaster and to enhance its keeping, would "boil down" belladonna extract to a hard and tough mass. They produced handsome goods, but they might just as well have omitted the belladonna; as experience has taught that continued heat above 100 is injurious, 115 very dangerous, and a short time above 120 will ruin belladonna extract.

One of the most important discoveries made by Johnson & Johnson, in connection with belladonna, is the method by which the whole operation of manipulating and spreading the plaster is done at a temperature not exceeding 100. Thereby preserving the activity of this delicate drug.

The use of india rubber in plaster bases was the first progressive step in plaster making that has been reached in centuries of pharmacy.*

India rubber has many qualities that make it one of the best gums to be used in a plaster mass. It has just the right stickiness at body temperature.

It acts well with most drugs.

It is waterproof, is fairly stable, but is a highly complex, treacherous substance.

After all the study and experiment in putting rubber into every conceivable shape, one cannot with any certainty tell whether a certain piece of rubber will spoil quickly or not. If the plasters keep the rubber is all right; if the plasters spoil the rubber is not all right. India rubber goods, which are vulcanized or cured to make them last, are only preserved under careful handling and are still uncertain. Plasters must be made of uncured rubber, and are much more subject to change.

India rubber, as it comes from the forests, is filled with vegetable and animal matters, fats, resins, wax and acids. In addition, it has been found that the secretions of the tree vary with the health of the tree, and the conditions of its growth.

This is true even of the finest grades of rubber, and to overcome them is the object of various processes used in the rubber industry. In plaster-making trouble will surely arise if these conditions are not wholly and carefully removed.

The various gums besides rubber that enter into a belladonna plaster must also be taken into account. If a piece of any gum, as found in the market, be melted and strained more or less dirt and foreign matter will be found mixed with it. These gums carry with them turpentine and acids that act upon raw rubber, and would re-act upon the constituents of belladonna. Their removal must be accomplished by washing in water, by neutralization of the acids, evaporation of turpentine products, and in some cases, by solution in proper solvents, straining and recovering the solvents. All these steps are preliminary to the mixing and spreading process, and are factors that determine the efficiency of the plaster as a remedial agency, as well as its quality as an article of trade.

*(Mr. Johnson was the first to combine india rubber in the pharmacopoeal plaster masses.)

The mixing of a plaster mass and the process of spreading has often been described.*

Belladonna plaster-making means, in brief, a thorough exhaustion of Belladonna root by maceration and percolation; then a concentration of the extract to a proper consistency.

In these processes extreme care is necessary, that the resulting extract may not be in any way injured. The prime requisite is that the plaster shall hold the constituents of belladonna in a condition to be readily absorbed. It must not be too soft nor yet too hard, but have a uniform degree of solubility in order that the drug may pass into the skin and tissue.

The extract is mixed in the cold with the gums olibanum, burgundy pitch galbanum, resin, etc. These gums have their use as assistant to adhesiveness and aid in holding the plaster mass close to the skin. Galbanum is quite active as a promotor of absorption. The wax and oil aid in keeping the mass in proper consistency and holding the constituents of belladonna in soluble form. Boric acid is a most important agent, aiding as a solvent for the drug, but acting largely as a mild detergent upon the skin secretions, dissolving the clogging matters in the skin pores, and greatly aiding absorption. It has its value also in preserving the mass from change.

The operation of mixing and spreading on cloth requires care and skill that comes only with thorough training, one must have quick hands, an eye on the thermometer and quick discernment as to when the proper plasticity is reached. These with accurately adjusted apparatus guided by a good, clear-headed judgment are pre-eminent requisites in the spreading of a belladonna plaster. As soon as spread they should be covered from light and air, cut in sizes, wrapped and packed into boxes. The quicker this is done the better results will follow, whether for a trade article or healing agent.

Why do plasters spoil? Such a question is often asked and is pertinent to any make, for none are exempt. The maker who produces plasters simply to sell probably has less complaints than anyone else. He uses little rubber as possible, loads up with absorbing powder-fillers that take up the products of decay. The plasters look all right and sell; a cheap, poorly made plaster often has the requisite of keeping unchanged.

One reason why india rubber plasters change is because they are made of india rubber. India rubber cured by the best known method is very liable to change. Plasters are made of uncured or raw rubber, made plastic, in other words carried very near a point of self-destruction. Several conditions hasten decay, such as frequent changes of temperature, or continued heat above 100°. Warm, moist temperature will not only affect the rubber but may start mould in belladonna. A great element to cause change is light. The heat, the chemical and the light rays of the sun all act injuriously on raw rubber. The direct rays of the sun will start decomposition in a few seconds; in an hour's sunlight a plaster is hopelessly ruined. Reflected light acts in the same manner, but less energetically. Oxygen is destructive to rubber and the alkaloids of belladonna; in the

*Mr. Johnson's method of making was incorporated into the 16th edition of the United States Dispensatory (see Emplastra page 555), and was also described in detail in various pharmaceutical journals. Mr. Johnson was the first to lift the veil of secrecy that covered the making of india rubber plasters, and to give the pharmaceutical profession the full benefit of his discovery and experience.

form of ozone it is very energetic. Air, especially when its conditions are changeable, aids decomposition. Many things combine to induce change in a plaster made with a rubber base, resulting in the breaking up of rubber, loss of elasticity, formation of new compounds all more or less ruinous to the plaster. All the factors that cause change in plasters are not under the control of the maker. Plasters are often seen lying open on counters, in windows and under skylights, in utter disregard of the facts here named, and which the plaster maker has labored to avoid.

Belladonna plasters are exempt from some of the difficulties which surround other rubber plasters. Properly made belladonna extract acts in a measure as an enveloping preservative surrounding india rubber particles. Alcoholic extract of belladonna root will not mould as easily as the extract of the leaves. The boracic acid and gums in the Johnson & Johnson formula all aid in staying change. This formula is the result of practical experience with every known base and method of making plasters. They should not change in two years. Specimens are in existence fifteen years old.

In view of the nature of an india rubber plaster, and the ease with which fresh stocks may be obtained, it would seem advisable that consumers, retail dealers and physicians should not keep them long. Slow selling plasters and kinds not frequently demanded should be obtained only as needed. Not more than a six months' supply of belladonna plasters should be kept in stock.



Physiological Action of Belladonna.

When the smallest physiological dose of atropia is administered to man, the only symptom induced is dryness of the throat and mouth, and possibly some disorder of vision. When a little larger amount is given, this dryness is more

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Abstract by permission from "Therapeutics, Materia Medica and Toxicology."

intense, and is associated with redness of the fauces, dilated pupils, disordered vision, and possibly diplopia. The pulse is sometimes at first rendered less frequent, but this decrease is very transient, and certainly in many cases cannot be demonstrated at all. Often from the first, certainly after a short time in all cases, the heart's beats, after a large dose of the alkaloid, become excessively rapid, the pulse rising to one hundred and twenty, or even one hundred and sixty; and in a little while a peculiar bright-red flush appears on the face and neck, and may spread over the whole body. As I have seen this it lacks

the punctuations of the rash of scarlet fever, and is only in very severe cases followed by desquamation.

Early in the course of the symptoms of atropia-poisoning there is very often forcible expulsion of urine, and erections of the penis may occur; but afterwards there is generally, Harley says, retention of urine. With the symptoms above enumerated, intellection may remain perfect; but there are generally some lightness of head, giddiness, and confusion of thought, as well as a staggering gait and restlessness. Occasionally, even with doses which may be called medicinal there are spectral illusions. Drowsiness is not a general or at all characteristic symptom; if present, it is apparently always produced indirectly, as by the removal of some cause of previous wakefulness. When a decidedly poisonous amount of belladonna or its alkaloid has been taken, all the symptoms already noted are intensified, and to them is added a peculiar talkative delirium, in which the patient lives in a world of his own, engrossed by the spectres and visions which throng him, and completely oblivious to the surrounding realities. Sometimes this delirium is wild, and the patient almost uncontrollably violent. After some time sleep may come on, and on waking from this, complete consciousness may be regained, or the symptoms may gradually subside. After a very large amount has been taken, severe convulsions may appear in a very short time, and per

with or without furious maniacal delirium, until near death. Sooner or later; however, the delirium subsides into stupor, and the convulsions into paralysis, and when the dose has been enormous, and especially when the alkaloid itself has been taken, stupor, with great muscular relaxation, may occur very early. lividity of the face, and evident imperfect aeration of the blood, are not seen in atropia-poisoning, except in a stage of most eminent peril. Death is preceded by marked failure both of the heart's action and of the respiratory forces. In most cases, I think, it is actually brought about by asphyxia.

Upon the lower animals belladonna to a great extent acts as upon man, though its influence is much less powerful in them, and very much larger doses are required. Seeming indifference of action are in most cases simply apparent, not real.

It follows that atropia in toxic doses paralyzes either the trunk or peripheral elements of the nerve, most probably the latter.

Upon the heart itself atropia acts as a direct depressant poison, but for this influence to be apparent a very large amount of the alkaloid must be used.

Atropia acts on the cardiac accelerator nerve-centres, or possibly nerves, as a stimulant, and, unless it be in lethal doses, does not destroy excitability of these nerves.

The relation of belladonna to the vaso-motor nervous system is of such practical importance that it deserves the closest study.

The evidence derived from direct observation of the capillaries seem to me to be, on the whole, decidedly in favor of their contraction by minute doses of belladonna.

I am forced to give assent to the proposition that atropia, in not too large amount, is a stimulant to the vaso-motor centres; a conclusion in harmony with the action of the drug on all the other motor centres. All observers agree that in the advanced stage of atropia-poisoning, after the blood-pressure has commenced to fall, there is dilatation of the capillaries. It seems most probable that this is due to a direct action of the poison on the muscular fibres in the coats of the vessels; for when directly applied to the web of the frog's foot, atropia, after a time, produces an evidently paralytic dilatation.

Action upon the Nervous System.—The delirium which is so characteristic of atropia-poisoning shows that it has especial relations with the cerebral cortex.

There can be no doubt that in the higher animals atropia acts upon the cerebrum as it does in man, producing the same peculiar delirious intoxication often ending in stupor. It is not necessary to discuss the matter further, except to remark that belladonna is not a hypnotic. The fact that the exhibition of a remedy is followed by sleep in disease is no proof that the remedy is in a proper sense a hypnotic. No one would give oyster soup such a cognomen, yet in certain exhausted wakeful states of the system such food may bring back sound sleep. If belladonna ever acts as a hypnotic, it is in this indirect way, by removing some cause of abnormal wakefulness. It can never be relied on, like opium, to induce sleep.

Action on the Voluntary Muscles.—The voluntary muscles escape unscathed in atropia-poisoning. It is true that Lemattre has shown that the contractility of a striated muscle may be destroyed by soaking it in a very concentrated solution of the alkaloid; but long before any such action can take place in

life the animal is killed; consequently after death from belladonna the contractility of the voluntary muscles is found impaired.

Action on the Abdominal Canal.—On the non-striated muscles the action of the drug is pronounced, but its exact nature is uncertain. It appears that in full doses atropia paralyzes the smooth muscular fibres of the intestine, bladder, etc., and it may be that in any dose it depresses that activity directly, but that, it paralyzing more quickly the inhibitory apparatus, it sometimes places the intestinal muscular coat in such a position that it will respond more vigorously than normal to external stimuli, and also that very minute doses may cause quiet by producing inhibitory stimulation. This view is borne out by the fact that the smallest dose used by Keuchel was 0.075 gr.; by Ott, 0.115 gr., both observers experimenting on the rabbit. When Ott used 0.45 gr., he got the same result as did Keuchel.

Action on the Respiratory System.—It has already been stated that in man small doses of atropia do not affect the respiration, whereas large doses accelerate it. The same is true in animals; and the acceleration takes place even when the vagi have been previously divided,—a proof that it is due to a direct stimulation of the respiratory centres in the medulla. When very large fatal doses are administered, there is evidently also a paralysis of that portion of the peripheral pneumogastric nerve which is connected with the function of respiration.

Action on the Glandular System.—One of the earliest and most notable effects of medicinal doses of atropia is dryness of the mouth, due to suppression of the secretions of the mucous and salivary glands. The action of the alkaloid upon the skin is similar. It can scarcely be doubted that this arrest of secretion is nervous; and the experiments of Keuchel indicate that it is due to an action upon the peripheral nerve-filaments.

Elimination.—When atropia is exhibited medicinally it probably all escapes from the body through the urine; and even after poisonous doses the amount eliminated through other channels must be almost infinitely small.

Action on Secretion.—After small doses of atropia the urine is increased,—sometimes, according to Harty, doubled. I am confident, however, that this increase varies very much, and is not always marked. After very large toxic doses the urine may be at first increased, but it is usually lessened very early, and in the later stages may be entirely suppressed.

In regard to the secretions of the alimentary canal, the action of atropia is very uncertain. I cannot find, however, any experiments that seem to me at all decisive; and clinical evidence certainly indicates that the alimentary secretions, if affected at all, are increased.

Action on Temperature.—In moderate doses atropia causes a pronounced rise in temperature, but in very large decidedly toxic amounts it lessens animal heat.

Summary.—From what has been already stated, it is evident that the action of atropia in therapeutic and in toxic doses is in a sense quite different.

In full medicinal doses it produces a sort of febrile state, with dryness of the mouth, increases rapidly and force of the circulation, quickened respiration, elevation of temperature, and secretion of febrile urine. The rapidity of the heart's action is due to paralysis of the peripheral inhibitory nerve and to stimulation of the accelerator nerves; the increased arterial pressure, to the increased

cardiac action, together with the general contraction of the capillaries, the result of excitation of the vaso-motor centres. The spinal cord is not sensibly affected by these doses; the motor, and probably to a much less the sensory peripheral nerves, suffer lessening of functional activity, although the influence of therapeutic doses of atropia upon them must be slight. If the dose be sufficiently large, the cerebrum is thrown into a condition of mild delirium, resembling also that of fever.

After decidedly toxic doses of atropia, the blood-pressure falls, from dilatation of the capillaries, owing to the paralysis of their muscular coats, and from direct relaxing of the heart-muscle. The temperature also falls; the muscular system is relaxed, and sensation is impaired, from the paresis of the motor and sensory nerves respectively; yet convulsions may now occur from the over-activity of the reflex centres, the predominance of paralysis or of convulsions varying with the dose, as the depressing or stimulating influence is the more powerful. Delirium recedes stupor, which in turn precedes death, from asphyxia, caused by failing trunkal nerve-functions or very rarely from syncope, caused by failure of the cardiac muscle.

Local Action.—It is evident that when belladonna is applied to a part it must act locally as a paralyzant, no doubt overpowering the capillary walls, the sensitive and motor nerves, and even muscular and glandular cell-action; for, except in the case of the latter, experimental evidence has already been brought forward to prove that, locally and freely applied, belladonna is a sedative poison, and clinical evidence points very strongly to its exerting a similar influence upon gland-cells. A Zeller (*Virchows Arch.*, lvi, p. 384) has found that a one per cent. solution of atropia brought in contact with the blood, outside of the body, has a decided influence in arresting the movements of the corpuscles.

Action on the Eye.—Our knowledge of the action of atropia upon the pupil may be summed up as follows: Atropia applied locally causes mydriasis by paralyzing the peripheral ends of the oculo-motor nerve, and probably by stimulating the peripheral ends of the sympathetic. Atropia given internally almost certainly causes, mydriasis, not influencing the nerve-centres, but by being carried in the blood to the eye itself, and there acting precisely as when locally applied.

The Action of Belladonna.

I. Atropine is the active principle of belladonna and it assumes all the properties of this solanum.

II. The intensity of effects is varied according to species; the herbivorous animals are less sensitive to the action of atropine while the carnivorous are more sensitive; the poison is especially violent on man, but there is no animal refractory to it.

III. The effects vary according with the different doses; small doses accelerate the action of the heart and increase the pressure; poisonous doses decrease the pressure and retard the action of the heart.

IV. Belladonna is a vasculo-cardiac poison, according to the classification of Prof. See. Its action is especially localized upon the vessels producing innervation of the heart.

V. The varied phenomena produced by atropine depend in most cases upon rimordial and elective action, or are due to the elimination of the poison.

By
Andre Isadore Meuriot,
Thesis, "De la Methode Physiologique et Therapeutique et de ses Applications a l'etude de la Belladonne, Paris."
(Translated for this work.)

VI. Atropine acts upon the heart by the medium of the pneumogastric nerve, of which it paralyzes the peripheral extremities. It constantly increases the frequency of the pulsation of the heart.

VII. In small doses it increases the tonicity of the vascular muscles; in poisonous doses it diminishes and even destroys this. Due to this quality is its application in epilepsy, which seems to be caused by modification of cerebral circulation.

VIII. The variations in the arterial pressure are subordinated to condition of excitement or paralysis of muscular coat of the vessels.

IX. Atropine in small doses accelerates the respiration and in poisonous doses retards.

The acceleration of the respiratory movements depends upon the excitation of the respiratory centres; what follows is due to the paralysis of the extremity of the vagi nerves; according to this quality it is used in cases of asthma.

X. Atropine in therapeutic doses augments the exito-motory functions of the spinal cord, rather than diminishes it. In poisonous doses it exaggerates the reflex powers to the extent of producing convulsions.

XI. Atropine always produces agitation, sleeplessness and delirium, and in poisonous doses coma. It is not a narcotic.

XII. Atropine is eliminated by the kidneys, by the mucous membrane and sometimes by the skin, in man. Its elimination is always rapid; its action of short duration.

XIII. The effects due to the elimination of atropine are numerous; such as, the redness of mucous membrane and the skin, the inclination to frequent urination, colics, gripes, anal and vesical tenesmus, profuse perspiration and diarrhoea, etc.

XIV. The redness and dryness of the mucous membrane accounts for aphonia, dysphagia, dysuria, etc.

XV. Not only are the secretions of the mucous membrane diminished, but also, on account of the activity of the circulation, a rapid absorption of all the liquids from the surface of the mucous membrane. On this account it is used for exaggerated secretions of mucus, and its effects in cough, etc.

XVI. The local application of atropine upon the tissues produces always an activity of the capillary circulation, and used in large doses real hyperæmias and stagnation of blood.

The process of angina and erythema by belladonna is analogous to the inflammatory process.

XVII. The modifications of urinal secretions are dependent upon the variations of the arterial pressure.

XVIII. Belladonna is not a paralyzing agent upon the smooth muscular fibres; it produces phenomena of paralysis only in very large doses, and is always consequent to exaggerated contraction, hence it is effective in incontinence of urine and fecal matter, in paralysis of bladder, in constipation, in irreducible hernia, etc.

XIX. Atropine has no elective action upon the sensory nerves. Its local application is always followed by severe and persistent pains. Atropine acts only upon the hyperæsthesical nerves, and often causes analgesia, but it must be applied directly upon the affected nerves.

XX. Small doses of atropine increase the temperature and poisonous doses diminish.

XXI. Atropine possesses, beside this, the special property of dilating the pupil. This is the most constant and persistent effect, and its applications are numerous in ophthalmia. The atropine paralyzes the terminating branches of the third pair of nerves; this fact is clearly demonstrated by experimental physiology in the study of mydriasis by belladonna. With this paralysis of the ciliary branches of the ocular motor nerve is connected the paralysis of the muscle of accommodation.

XXII. Certain experiences, and some considerations which we have made known, show the exciting action upon the sympathetic or upon the dilator; nevertheless, a more rigorous demonstration is needed.

General Conclusions.

As to Physiological and Therapeutic Action of Belladonna.

1. The extract of belladonna being very hygrometric is easily altered.
2. The belladonna is a poison as well to man as to most of animals.
3. We can use it gradually in doses of 40 or 50 centigrammes, and even more according to the effects we wish to produce and the individual.

From "Recherches sur quelques Points de l'action Physiologique et Therapeutique de la Belladone," by

A. Dordelu,

These pour le Doctorat en Medecin, Paris, 1879.

(Translated for this work.)

4. Women seem to be more susceptible to the effects of the poison than men.

5. The organism soon becomes accustomed to the action of belladonna.

6. The elimination is very rapid and consequently the effects are of short duration.

7. We often have to vary the doses in order to keep the organism under the influence of the medicine.

8. The pulse is ordinarily increased while the temperature remains stationary.

9. The vision is affected, the pupils become dilated, sometimes unequally, and always susceptible to contraction.

10. Belladonna causes often polyuria and dysuria. The polyuria seems to depend upon the quantity of liquid absorbed.

11. The secretion of saliva is greatly diminished.

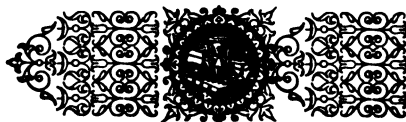
12. There is always a very great dryness of the throat, accompanied by excessive difficulty in deglutition and sometimes by a loss of taste.

13. We have never observed in our patients, sleeplessness, delirium or hallucinations.

14. Belladonna often causes heat and dryness of the skin.

15. It is a muscular relaxative. (Gubler.)

16. The use of belladonna is advised in whooping-cough, epilepsy, asthma, incontinence of urine at night, the perspiration of phthisics, and certain cases of neuralgia.



The Local Actions of Belladonna.

Belladonna when applied to the skin as a plaster, liniment or ointment in large quantity may be absorbed sufficiently rapid to produce all the symptoms that are developed when it is taken internally. There may be dryness of the

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Extract from lecture.

throat, the pupils dilated, the vision disordered so that near objects cannot be so easily seen or there may be even double vision. At the very beginning of the action of the drug the pulse may be for a brief time slower, but very soon it becomes faster. The breathing may become more rapid and deeper. In a person with a thin white skin a bright red flush may appear on the face, and later may

spread over the entire body. In susceptible persons there may be even a wild talkative delirium. Since it is not applied to the skin for its constitutional but its local action, the manifestation of these objectionable symptoms indicates that the quantity applied is too large, and should be reduced. When applied locally in quantities too small to produce a constitutional disturbance it can cause appreciable as well as useful actions on the following mechanisms :

1. The sensory mechanism.
2. The motor mechanism.
3. The secretory mechanism, and
4. The ocular mechanism.

Sensory Mechanism.

Belladonna relieves pain. I will first tell you how it lessens pain, and then why it is far more efficient when applied locally than when given internally.

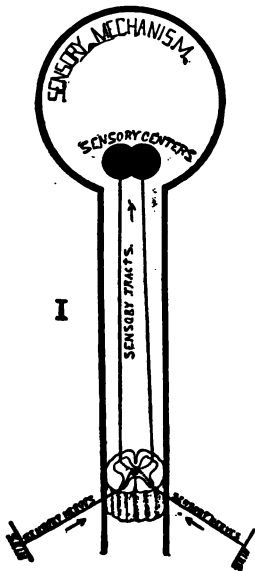
When a drug lessens pain, it does so by depressing some part of the sensory mechanism. The possible points in the mechanism where a drug may act are as shown in diagram I.

First, the receiving centre in the brain.

Second, the sensory tracts in the spinal cord, and

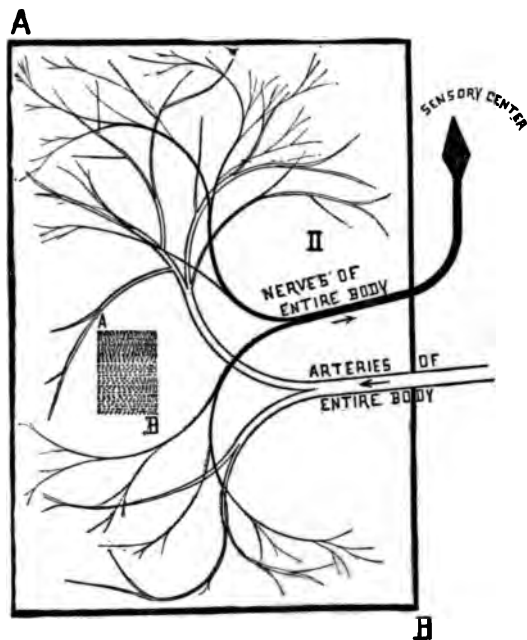
Third, the ends of the sensory nerves.

Some drugs diminish pain by depressing the receiving centre so that the impression transmitted from the periphery cannot be received. This is the way morphine mainly lessens pain. Other drugs do so by depressing the sensory tracts so that they cannot conduct the impression to the brain. Caffeine is supposed to lessen pain this way. Or again other drugs act as anodynes by depressing or paralyzing the ends of the sensory nerves so that they are not susceptible to irritation, and hence do not receive the impression to be conveyed to the brain. This is the way such drugs as belladonna and cocaine relieve pain. Belladonna has no action on the receiving centre or the tracts, but it has a very marked depressant action on the ends of the sensory nerves.



have now told you where it acts to deaden pain, I wish next to tell you why its action is a thousand times stronger when applied at seat of pain than when given internally. If the anodyne action of a drug is due to depression of central acts, then it not only is

to apply it over the area of pain, but it will act much more efficiently if given internally so that it can easily reach these structures. It is for this reason, therefore, the most potent anodyne known, is rarely used as a local liniment (though it should not be forgotten that it has a slight action on the ends of sensory nerves). But if it acts as an anodyne by acting on the sensory ends it is better to apply it directly to the seat of pain, if it is accessible, than to give it internally, because the whole dose is concentrated in contact with the nerves that are affected, whereas, if it is given internally the dose is



by being mixed with the whole quantity of blood and carried to all the other parts of the body as well as to the area of pain. This is evident from the accompanying schematic drawing (Cut II). In the large rectangle A B represents the area of the whole body, the small rectangle a b, the area of pain, the dose is as many times greater as the large contains the small rectangle. Such drugs as belladonna and aconite when applied locally cause anaesthesia over the area of application, but to produce this by giving one of these drugs internally would be necessary to give sufficient to produce general cutaneous anaesthesia, that is it would require a toxic dose. It is for this reason that belladonna is of such great service in relieving pain and reflex phenomena due to peripheral irritation. In asthma, smoking the leaves bethe sensory ends in the respiratory mucous membrane and lessens reflex bronchial spasm. The liniment, ointment or plaster applied to the chest is a very common and efficient means of relieving the pain of intercostal neuralgia, pleurodynia, lumbago and the various forms of myalgia. Irritability of the chest muscles seen in phthisis is lessened by belladonna, also the pain from old adhesions due to pleurisy are relieved, especially by the plaster, which acts as a splint, lessening mobility of the chest wall, at the same time it is anodyne. The pain in chronic rheumatoid gout for a similar reason are benefited. Belladonna is pre-eminently indicated for the relief of these various peripheral irritations, because it acts at the

seat of the morbid process, because in the dose given it does not act anywhere else, causing derangement of the system as occurs when such drugs as morphine are given internally. The plaster is usually better than the liniment or ointment:

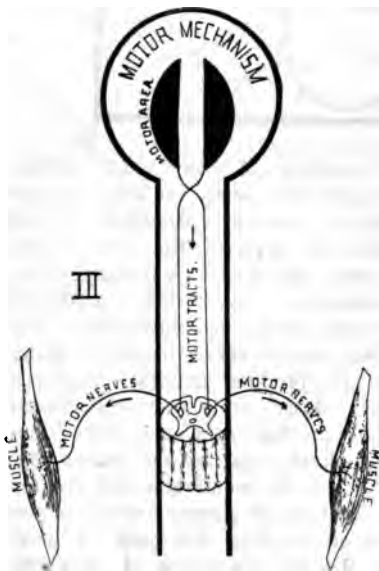
- 1st. Because it is cleaner and does not soil the clothes.
- 2d. Because it is more slowly dissolved, and hence its action is more continuous
- 3d. Because it protects the skin from the cold, and in that way partly relieves the pain, and
- 4th. Because it acts as a splint, lessening the mobility of the painful area; this specially applies to the chest.

Motor Mechanism.

Belladonna diminishes muscular spasm: when a drug lessens spasm it is by depressing some part of the motor mechanism. The points in the motor mechanism where a drug may act to lessen spasm are as shown in diagram III:

- 1st. The cerebral motor areas,
- 2nd. The spinal motor areas,
- 3rd. The spinal motor tracts,
- 4th. The ends of the motor nerves, and
- 5th. The muscles.

Belladonna probably acts on more than one part of this mechanism; however, the phenomena is very complicated and its action is by no means yet thoroughly understood. This much though, is known, that when applied to the skin or injected directly into a muscle it depresses the ends of the motor nerves so that impressions cannot be conveyed to the muscles, but are stopped just before reaching the muscle, and hence belladonna in this way can relax spasm. For the same reason that it is far more efficient as an anodyne when applied locally, it is more active as an antispasmodic when injected into the muscle or applied over it. If it diminished spasm by depressing cord or brain of course its local application would be of no service. Because it relieves pain and spasm, belladonna suppositories or ointment are very useful to relieve the spasm of sphincter ani from fissure. The ointment applied along the urethra greatly lessens the spasm of urethra that some times occurs in gonorrhoea. It is also used for rigid os uteri.

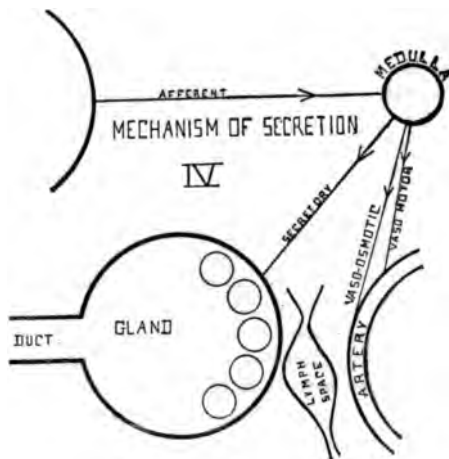


The spasm occurring in rheumatism and torticollis is benefited by belladonna applications.

Secretory Mechanism.

No drug in Materia Medica is such a powerful depressant of glandular activity as belladonna. Before presenting its mode of action on the glands, I will briefly

describe the mechanism of secretion and the points in it where a drug can act, as shown in diagram IV. The mechanism consists of the secretory cells, lymph spaces, arterioles and a nervous mechanism presiding over these. Omitting here any mention of a local mechanism, remember that there is in the medulla centre to which, in those glands that are reflexly excited, afferent nerves pass, and from which, in all glands, efferent nerves pass to the glands. These latter as shown in diagram IV consist of secretory fibres, vaso-constrictor and vaso-dilator fibres, which regulate the size of the arterioles, and probably also vaso-osmotic fibres which regulate the osmosis of the serum into lymph spaces. The parts of this mechanism on which a drug may act to affect secretion are :



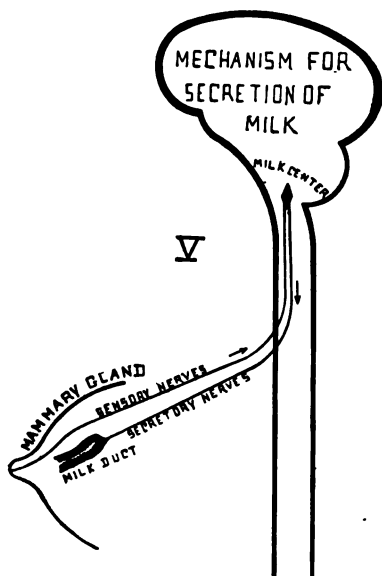
1st. The ends of the different nerves, whose function is to excite reflexly secretion.

2nd. The centre in the medulla, whose function is both automatic and reflex.

3rd. The ends of the various efferent nerves distributed to the gland, and

4th. The secreting cells. Elaborate experiments made on the submaxillary gland show the exact point where belladonna acts to dry up the salivary secretion.

It depresses the ends of the secretory nerves so that the stimulation is cut off from the secreting cells; it also appears to arrest osmosis of the serum from the capillaries into the lymph spaces; probably by depressing the ends of the vaso-osmotic fibres. It has also been proved that it dries up the secretion of milk and sweat in the same way. If it depressed secretion by acting on the centre in the medulla it is evident that it would be better to give it internally than locally, but since its action is peripheral it is far more efficient, when possible, to apply it to the gland. For this reason the liniment or ointment is often used to check the local sweating of the hands and feet. Again, when the child dies or for other reasons it is desirable to dry up the secretion of the milk, there is nothing better than the application to the breast of belladonna, either as liniment,



ointment or plaster. It is far superior to remedies given internally, because it

diminishes the secretion without producing other actions on the system, unless it is applied in too large quantity.

The reason why belladonna is such a prompt and certain drug for drying up the breasts will be made clearer by reference to diagram V, by the aid of which I hope to show you that belladonna, instead of having only one action, has two local actions. The nervous mechanism presiding over the mammary gland consists, as shown in diagram, of :

- 1st. The milk centre in the medulla.

- 2nd. The efferent nerves, consisting of the secretory, vaso-dilator, vaso-osmotic nerves.

- 3rd. The afferent nerves, consisting of the sensory nerves from the nipple. The secretion is excited,

- 1st. By the continuous stimulation transmitted over the secretory fibers from the automatic centre in the medulla.

- 2nd. By irritation of the nipple during sucking, which is transmitted by the sensory nerves to the milk centre and reflexly excites secretion. With this prefatory statement of the physiology of secretion, you are now prepared to understand the action of belladonna on the function of the mammary gland. Belladonna arrests secretion of milk :

- 1st. By depressing the ends of the secretory nerves so that the gland is partially cut off from the influence of the milk centre. It also probably lessens osmosis.

- 2nd. By depressing the ends of the sensory nerves of the nipple so that they cannot reflexly excite secretion.

Belladonna is also of service in mastitis probably by retarding osmosis from the capillaries.

Ocular Mechanism.

Atropine, when taken internally in large enough dose, dilates the pupil, paralyzes the muscle of accommodation, and changes the intra-ocular pressure. But when dropped into the eye in a dose too small to produce systemic disturbance, it can cause this ocular phenomena. It has been proved by numerous exact experiments that its action is peripheral instead of central. Atropine dilates the pupil by paralyzing the ends of the third nerve distributed to the sphincter muscle so that it relaxes, and also by stimulating the ends of the sympathetic distributed to the dilator muscle, so that by its contraction the iris is drawn back. Morphine contracts the pupil by stimulating the root of the third nerve, hence it would be useless to drop morphine in the eye to contract the pupil, when it would have to be absorbed, and pass to the centre before it could act.

Physostigmine contracts the pupil by stimulating the sphincter muscle, nicotine by stimulating the ends of the third nerve. Atropine disorders vision so that a person cannot see near objects, as the letters in reading a book. It does this by paralyzing the ends of the third nerve which innervate the muscle of accommodation. Atropine is of great service in treating some of the affections of the eye and, because its actions are peripheral, it is never used internally, but always externally in the treatment of diseases of the eye. Belladonna depresses the peripheral part of nearly every nervous mechanism, hence it has a wider field of usefulness in local treatment of the various ailments of the body than any other drug in the *Materia Medica*.

Belladonna Plaster in Vomiting.

Bretanneau paid great attention to the action of belladonna, and recommended it in the incoercible vomiting of pregnancy. Bretanneau used frictions of the extract diluted with water rubbed over the hypogastrium two or three times a day. In most instances this relieved the vomiting of pregnancy when all other means had failed.

Belladonna applied thus will be absorbed by the skin, and relieve the morbid irritation of the uterus, which is the cause of the vomiting. It will also modify the irritation of the stomach itself.

Abstract translated from Address by

Guéneau de Mussy,

Societe de Therapeutic, Paris.

The writer (Dr. Guéneau de Mussy), has applied this treatment, the external use of belladonna, for twenty-five years, to all descriptions of vomiting, whatever the cause might be. He found the plaster of belladonna much better than the use of the extract.

The plaster allows a continuous application to be made, is much more clean, and does not require the renewal of the application, and can be applied by the patient. There is also no staining the clothing.

A piece of plaster usually about twelve centimeters in diameter is applied to the epigastrium. The plaster is allowed to remain twelve to fifteen days without being removed. It can then be renewed, but it is necessary not very often. Only one case among several thousand where the belladonna plaster has been thus applied has any ill effects resulted. This was owing to an idiosyncrasy on the patient toward the drug.

It is not to be asserted that this means always succeeds, but it has succeeded in a great number of cases. (Cited in original paper.) Generally it either entirely relieves the vomiting or greatly mitigates and affords speedy relief.

The success of the plaster in vomiting suggested its use as a prophylactic and curative in sea-sickness and its vomiting distresses. In the cases (cited in the paper) there were those who could not put their foot upon a vessel without being tortured with sea-sickness; others who always arrived in port in a state of exhaustion and semisyncope. Old travelers who suffered from repeated and obstinate vomiting during sea voyages, constant victims of sea-sickness, and novices were able by the proper application of belladonna plaster to be relieved of their distressing experiences, and to secure comfortable voyages even in rough and stormy passages. The method generally pursued was to apply the plaster over the epigastrium upon starting, which seemed to overcome partially or completely the tendency to vomiting. Sometimes it was necessary to renew the plaster during a rough sea, or in an extended voyage to replace it when it had been removed. In the worst cases a slight nausea, or slight attack of vomiting, for the first hour at sea, was experienced.

Great hopes are entertained of the benefits to be derived from the use of so simple a remedy, and it deserves an extended trial in this extremely painful affection, which has hitherto resisted all measures of relief.

Belladonna Locally.

As an Anti-Galactagogue.

Mammary abscess resulting from over distention of the lactiferous ducts is of frequent occurrence, and is alike a source of suffering to the patient and annoyance to the attendant. Every practitioner is familiar with the difficulties attending the management of the mother on the loss of her child, either on parturition or subsequently, in securing prompt and systematic removal of the lacteal secretion either by natural or artificial aids, until the functional activity of the organ is arrested or gradually ceases. It also occasionally happens that the mother, in attempting to wean her child, finds the established physiological ac-

tivity of the mammary gland so persistent, that secretion continues even when its natural stimulant, nursing, is discontinued, so as to be productive of inflammation and suppuration. For some years I have been in the habit of using belladonna, applied locally, for its anti-galactagogue effect, and

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thus used have found it of signal benefit. My method of application is as follows: I cut out a circular piece of belladonna plaster of sufficient size to cover the breast, with a hole in the centre about an inch in diameter for the nipple. I give the three following as typical cases of the efficacy of belladonna locally applied in arresting and preventing the lacteal secretion: Mrs. Cc.—Was first called to prescribe for mother on the day succeeding her child's death; found both breasts swollen, hard and very painful from distention and inflammation of lacteal vessels. The integument covering breasts was livid, and I thought immediate suppuration unavoidable. I carefully applied belladonna plaster, covering both breasts; within a few hours of the application marked relief from pain was experienced. The plaster was allowed to remain several days. The inflammation gradually subsided, and there was neither formation of abscess nor further secretion of milk. Her getting up was prompt and in all respects satisfactory.

Mrs. B.—Foetus had been dead three or four weeks prior to labor. Applied belladonna plaster six or eight hours after labor. She experienced no secretion of milk whatever, and in three weeks was about the house, apparently in perfect health.

Mrs. H.—Delivered November, continued to nurse her child until August, when she weaned it. Here the secretion continued to such a degree as to greatly extend the breast, occasioning excruciating pain; and threatening inflammation and abscess. Belladonna plaster was applied over both breasts with the effect of relieving the pain in two or three hours, after which no further secretion took place.

I have never failed in arresting the lacteal secretion by this method when the plaster has been of good quality and its adhesion to the integument perfect. It was a question in my mind whether the relation between the lacteal secretion and the physiological diminution in the tissues of the uterus following labor, was of such a nature as to unfavorably affect the health of the person were this function prevented or arrested; and I am happy to state, so far as I have observed, I could discover no injurious results. During the period of allaitement maternal, I consider the local application of belladonna of doubtful propriety; when used it threatened mammary abscess from over-distention of the lacteal vessels, owing to the danger of absorption into the mother's system, and its toxicological effect

being produced upon the child through its mother's milk. One such case of poisoning has been reported within the past few months. While proper precautionary care will almost always enable us to avoid mammary abscess from the causes already mentioned, they are nevertheless frequently met with from neglect or lack of knowledge of either the attendant or the patient. I consider belladonna a valuable therapeutic agent in cases like those here narrated, and I ask such members of the profession as have not thus used it to give it an impartial trial.

Belladonna Plasters.

In the Treatment of Diseases of the Skin.

Medicated plasters, especially in the form of soap and lead, have long been employed with advantage in the treatment of diseases of the skin. The number of drugs used in preparing medicated plasters, and the crude method of their manufacture, have greatly restricted their use. Further, the cutaneous affections to which they have been applicable have been until recent years also comparatively few. Little was either expressed or written upon remedies used in the form of

medicated plasters until 1879, when I called attention to their utility in certain diseases of the skin. Since presenting my first observation upon medicated plasters, I have continued to use them, and I am now able to report more agents so employed, better plasters, and more decided results. I have been greatly assisted recently in my observations by the use of fine, smooth and moderately adhesive plasters, produced through the co-operation of Mr. R. W. Johnson, a practical chemist of the firm of Johnson &

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Johnson, of New York. These plasters, so elegantly prepared, are spread on very fine muslin. They have as their basis a plaster mass which is composed of two parts of rubber, and one part of adhesive material. The drugs combined with this plaster are thoroughly incorporated. A plaster is thus formed which is fine, smooth and having moderately adhesive quality sufficient to make it stick close to the integument. These qualities are requisite for plasters from which medicinal action is expected by their continuous contact with the skin. Too often plasters that are termed medicated are spread imperfectly on poor muslin or some other substance; the basis is cheap and worthless, and the drug or drugs not properly incorporated. The resulting plaster is uneven, and the adhesive qualities very slight or too great, and the medicinal action negative or irritating to the diseased surface. Medicated plasters, to be beneficial in their application, should possess the qualities I have just recounted. Further, they are not of value in all forms of skin affections, but, as a rule, in chronic and localized diseases.

Medicated plasters are valuable for applications for certain regions, particularly for the face, neck, lips and feet, where it is almost impossible often to have ointments remain in contact with the diseased surface. In addition, they fulfill the triple purpose of protection, with moderate compression and medicinal application at the same time. Again, they are cleanly, and can be kept in continuous application, owing to the possibility of their retaining the secretions of the parts,

and thus developing heat, moisture and irritating action upon the integument. As a rule plasters, if used upon chronic and localized skin affections, and not allowed to remain too long in contact with the skin, will not produce this unpleasant effect. In some of the affections of the skin the plaster should be removed every day or two from the surface, and the two parts cleansed with either oil, glycerine, water and soap or water and an alkali.

In chronic spots the plasters can usually be left in contact with the surface for several days or a week at a time, and then the parts should be cleaned just as in using other dressings and the application wiped off and reapplied.

Belladonna plaster is one of the most effective plasters for relieving recurring patches of herpes, herpes zoster, neuralgia, and exalted and diminished sensibility of the skin. In isolated spots of the erythema, subacute and chronic eczema, it often relieves the accompanying obstinate itching and removes infiltration.

Fissured eczema, especially of the fingers and toes, may often be controlled and healed by encircling the parts with the plaster every two or three days. Localized, obstinate and irritable patches of vegetable parasitic diseases, especially ringworm and favus, may yield readily to the use of this plaster. The boracic acid in the combination is one of the most effective parasitic agents for the destruction of vegetable organism, and the belladonna acts well in relieving cutaneous irritation. The action of belladonna plaster in arresting the secretion of milk and in relieving inflammation of the breasts, is in this combination still more enhanced in its effect by the boracic acid. The absorption of the belladonna is found to take place more rapidly and the secretion of milk in the inflammation yield more promptly to the application of the two drugs in the form just suggested. Abscesses, boils, and carbuncles, inflamed sub-cutaneous glands, irritable scalds, frost bites, wounds and ulcers, may be benefited and at times speedily induced to heal by the local anodyne action of the belladonna and the antiseptic properties of the boracic acid.

Local Therapeutics of Belladonna.*

General Surgery.

Belladonna is known to possess the power of arresting the secretion of milk.

It is employed with advantage when, the mother being unable to suckle her child, the breasts become swollen and painful, and threaten to suppurate unless the tension of the ducts be relieved. If the milk cannot be drawn off artificially, the secretion must be suppressed. The drug should be applied before inflammation has set in, in which case the swelling and pain in the breast generally subside in a few hours, and the gland becomes soft and painless. Even if inflammation has already begun and the breasts have become tense, shining, hard, knotty, red, and acutely painful, an ointment of belladonna should be applied, and over it a warm flaxseed poultice, the entire breast being thoroughly

supported. This treatment, continued for forty-eight hours, will often arrest the

*These articles are abstracts from *Hand Book of Local Therapeutics*, edited by Harrison Allen, M.D. They are inserted by special permission of the editor and P. Blackiston, Son & Co., publishers, Philadelphia.

formation of pus. The method should be employed in all cases, no matter how far the mastitis has advanced. Even when the agent fails to prevent suppuration, it reduces the inflammatory process and lessens pain.

The addition of belladonna to iodine ointment increases its efficiency in the treatment of adenitis. This may be rubbed thoroughly into the inflamed part twice a day. An ointment composed of equal parts of ung. belladonna and ung. hydrargyri is of great service in conjunction with blisters, and rest, in the treatment of chronic synovitis of the knee joint. After counter-irritation, the part is to be enveloped in lint, on which is spread a thick coating of the ointment covered with waxed paper and firmly bandaged. John Ashhurst often uses this treatment with great success in the local treatment of peritonitis, the abdomen being covered with lint on which has been spread the ointment, and the whole enveloped with a large hot poultice. The application should be continued until slight ptialism is induced.

In the treatment of boils, carbuncles, and abscesses, it is an excellent plan to smear the inflamed tissues with an ointment composed of equal parts of extract of belladonna and glycerine, and on this dressing to superimpose a hot poultice. Belladonna plaster is largely used for the relief of pleurodynia, intercostal neuralgia, pleurisy, and muscle pains of rheumatism. It is also applied over the region of the heart in functional and organic diseases of that organ. The skin must be thoroughly cleaned with soap and water, and afterward washed with alcohol or vinegar. This will insure the plaster adhering, and at the same time promote absorption of the drug. Care must be exercised in the application of belladonna to large surfaces that have been denuded of epithelium. Belladonna used for its constitutional or its local effect, is much more active and prompt when in contact with the mucous membranes than when applied to the cutaneous surfaces.

In the genito-urinary tract of the male, belladonna is of great service for the relief of spasmodic stricture of the urethra, or spasm of the neck of the bladder, following over distention, a condition often met with after a debauch. It is also of value in the preparatory treatment of strictures of small calibre, especially those of an irritable nature. In all classes of conditions it is imperative that the patient should be brought under the influence of the drug, preferably by means of a suppository of half a grain of the extract of belladonna inserted into the rectum about half an hour before the proposed introduction of the instrument. In many cases what would otherwise be an impermeable stricture, can readily be passed. In some cases of tight stricture it is advisable to smear the instruments with the ointment of belladonna instead of sweet oil. By this means the local effect of the drug is supposed to be made more prompt and active. Care, however, ought to be exercised that too much of the drug does not find its way into the system from the mucous membrane of the urethra. It must be remembered that belladonna is of little service when the retention of urine is due to an enlarged prostate, as it has a tendency to paralyze the vesical expulsive muscles; and where the desire to pass water arises from the presence of urine which the bladder fails to expel, the difficulty is only aggravated by belladonna. In stranguary following the absorption of cantharides from large blisters, and also from the use of turpentine, belladonna combined with opium will prove a satisfactory remedy. In irritable spasms and neuralgic conditions belladonna may be combined with advantage with opium and camphor.

In orchitis immediate relief may be obtained by enveloping the testicle in lint on which has been spread a thick coating of belladonna ointment, and applying over this fomentations of hot water. In chordee, Mr. Hill recommends a suppository of extract of belladonna and morphine.

In fissure of the anus Dupuytren states that belladonna is of service in inducing relaxation of the sphincter. In the treatment of hemorrhoids belladonna is incorporated with many ointment bases. The selected part should be washed before the application of the ointment. Allingham recommends that when the masses are inflamed they be anointed with equal parts of extract of opium and of belladonna, and then be covered with a hot poultice, though in some cases a cold application may be found to be more grateful.

Diseases of the Skin.

Belladonna is employed in the treatment of hyperidrosis, and in affections of the skin where excessive sweating interferes with the action of other remedies.

By

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In excessive sweating of the palms and soles, or of the axilla, groins, etc., the tincture may be painted on the previously dried surface once a day, and followed by the use of an astringent powder.

The dried and powdered extract of belladonna may be employed as a dusting powder, and is particularly useful in eczema of the groins, thighs, scrotum, anus, and neighboring parts, especially when occurring in the summer season and accompanied by excessive sweating. It should be carefully mixed with a dessicant powder, as oxide of zinc, subnitrate of bismuth, starch, or fuller's earth. The proportion should be one to two drachms to the ounce of the excipient.

The extract of belladonna may be employed alone. (The official ointment is 48 grains to the ounce, but in referring to English works it is well to remember that the British preparation is twice as strong.) It is found useful as a dressing in painful ulcers, and also in other painful conditions of the skin as in eczema of the anus. It has a certain value also in pruritus ani. The constitutional effects should be guarded against.

Atropine is employed for the same purposes as belladonna. Its external employment is rare; usually it may be substituted by belladonna.

Diseases of the Ear, Nose and Throat.

Solutions of atropine in three to five grains to the ounce, are of value in rheumatic otalgia. One or two drops may be instilled at a time. Although its use is not contra-indicated by an opening in the tympanic membrane, it is necessary to bear in mind the ease by which the medicine may pass down the eustachian tube to the pharynx. E. D. Williams recommended the atropine treatment as one of the best at our command. Keene recommends atropine as a remedy for tinnitus. For the treatment of acute rhinitis the powdered leaves enter into the composition of a snuff as follows: pulverized leaves one scruple, morphine sulphate two grains, pulverized acacia a half ounce. Atropine is occasionally employed

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in the local treatment of laryngeal phthisis. Inhalations of water, in which a small proportion of tincture of belladonna has been added, relieves the pain of chronic laryngitis.

Diseases of the Eye.

Atropine is always used in the form of the soluble sulphate or salicylate, the alkaloid itself being very sparingly soluble in water. It is useful as a powerful local anodyne, but chiefly by its action in dilating the pupil and paralyzing the muscle of accommodation. Its exact mode of action is not yet definitely determined. It is known to be local. It must be absorbed and reach the iris directly before it can act. The aqueous humor of an atropinized eye contains sufficient atropine to dilate the pupil of another eye. It causes mydriasis when applied to the eye immediately after death, or, in experiments upon animals, after removal of the brain and spinal cord. Its action is upon unstriated muscle, and it does not affect the pupil of birds whose iris muscular fibres are of the striated kind.

Belladonna is extensively used in ophthalmic surgery. As a mydriatic the full effect of atropine may be rapidly obtained by a solution of four grains to the ounce. When one drop of this is instilled in the conjunctival sac of a healthy eye, the dilatation of the pupil commences in less than fifteen minutes, and attains its

By
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maximum, with complete immobility in twenty or twenty-five. Atropine is now, however, not so much used as formerly, for this purpose, as homatropine or cocaine involves much less inconvenience to the patient. Its most important therapeutic application is in the treatment of iritis, in which it is the remedy above all others. The great danger in this disease is adhesion of the iris to the lens capsule, and, in a large proportion of cases, is practically over when the pupil is once well dilated and its margin is thus withdrawn from contact with the lens. Unfortunately the action of the drug is resisted and too often can not

be induced unless the application is used at the commencement of the affection. The absorption of atropine by the cornea is diminished by the increased intraocular tension, and even before adhesions have occurred the hyperæmic and oedematous iris responds slowly and imperfectly to the action of the mydriatic. This action is materially promoted by the local abstraction of blood by means of leeching or cupping at the temple. When there is great increase of tension, paracentesis of the cornea is useful. Freshly formed adhesions may often be broken up, and even when the adhesions are firmer, partial and irregular dilatation can usually be obtained.

In cases of nuclear cataract, with the periphery of the lens comparatively clear, great improvement of vision is often secured by keeping the pupil continuously dilated with atropine instilled two or three times a week. By this proceeding and the careful correction of any existing defect of refraction, patients are often enabled to enjoy useful sight for months, or even years, before the whole lens becomes involved in the opacity.

In the treatment of phlyctenular keratitis, which is usually accompanied by considerable ciliary irritation with contraction of the pupil, atropine is valuable as a powerful sedative, and by putting the pupillary and accommodative actions of the eye at rest. A one or two-grain solution may be combined with ten grains of boric acid, or, if there is much conjunctival discharge, with half a grain of alum. In wounds involving the cornea and iris, a four-grain solution is commonly used.

Atropine is useful in most cases of keratitis, particularly in the acute form, with a painful and irritable condition of the eye. In cases of indolent corneal ulcer, or sloughing of keratitis, or when the intraocular tension is much increased, eserine sometimes acts better.

Atropine is not now nearly so generally used as formerly after cataract extraction, and is thought to increase the tendency to prolapse of the iris, particularly in the case of operation without iridectomy. Many surgeons use eserine to draw the iris away from the corneal wound. After the incision is healed, however, atropine is useful by dilating the pupil and contracting the blood-vessels of the iris. If iritis sets in its use is imperative. Dilatation of the pupil before the operation is secured by the application of cocaine, which is now almost universally used for its anæsthetic effect. It is customary to apply atropine both before and after the operation for solution.

Atropine acts more slowly on the accommodation than on the pupil. As, however, there is a decided variation in the susceptibility of different individuals, and a ciliary muscle irritated by excessive strain resists the action of the drug, to be sure of the full effect it is customary to make the application three times a day for a day or two. Attained in this way the effect does not usually disappear entirely in much less than two weeks.

Dispensing Plasters.

The dispenser has but little to do in dispensing belladonna or other plasters, prepared in rubber combination and cut into sizes. There are, however, some points that the careful dispenser should not overlook. Few drug stores have a perfectly convenient place for keeping plasters. They are thrown into closets, drawers, or under counters, from which they are dispensed under great inconvenience, covered with dust and injured by exposure. Yard rolls keep best standing on end in the can as they come from the maker. After use they should be replaced at once; this will obviate errors and enhance their chances of their keeping more perfectly.



SHOULDERS.

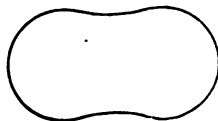
Cut plasters should always be kept in their original boxes with the cover closed. The containers are made strong and tight to insure cleanliness and preservation, and the dispenser should see that the plasters are kept in them. Plasters should always be kept covered with the face-cloth.



SIDE.

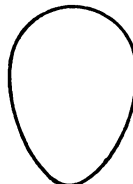
Sizes and Shapes of Plasters.

Belladonna Plasters (Johnson & Johnson) are put up in yard rolls 7 inches wide, 5 yard rolls 5 and 7 inches wide; cut (perforated) 5 x 7½ inches; breast plasters, round, 6 and 7 inches in diameter. From these sizes nearly every size or shape can be cut without waste.



BACK AND KIDNEY.

To cut rubber base plasters is very easy, but if they are cut with a knife it should be sharp and dipped in water just before cutting. A long blade shears, such as is used by tailors, is preferable to small scissors, and the plasters will cut more readily if the shears are wet. It is sometimes a good practice to outline the size and shape on the plaster cloth with a pencil, and then cut to the line. Square corners on plasters should be trimmed or rounded off, as the corners are apt to rub loose and become a disagreeable annoyance.



CHEST.

The illustrations show shapes for plasters in ordinary use.

The plasters for chest, shoulder, back and side can be cut from an ordinary porous plaster or from a piece of plaster about 5 x 7 inches. The ear plasters can be cut from a small piece. The breast plaster from a 7 inch roll.



SIDE, BACK, JOINTS.

The following sizes are translated by permission from a lecture by Dr. Rudolph Kobart (Director des Pharmacolog is-chere Institutes zer Dorpat), on "Emplastra."

Half sheet paper size: (Rectangular about 7½ x 11½ inches. (19 x 30 Cm.)

Quarter sheet paper size: About 5½ x 7½ inches. (15 x 19 Cm.) This is also known as size for trunk. An ordinary perforated (porous) plaster is very near this size.

Playing card size: 2½ x 3½ inches. (6 x 9 Cm.)

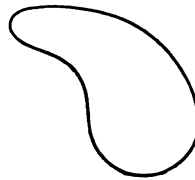
Size of surface of a man's hand: 3½ x 3½ inches. (8 x 8 Cm.)

Size for neck: 2 x ¾ inches. (5 x 6 Cm.)

Size for arms: 1½ x 2 inches. (4 x 5 Cm.)

Size for calves: 2½ x 4 inches. (7 x 10 Cm.)

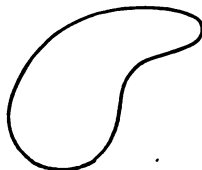
Size for temples: ¾ x 1½ inches. (2 x 3 Cm.)



RIGHT EAR.

Dr. Kobart says "that even if a plaster is made up and cut exactly right there is often a failure if it is not applied to the part where the effects are desired; *e. g.*, on a particular nerve-tract." The physician, therefore, should either apply the plaster himself, or mark the exact place of application upon the skin of the patient, with a pencil.

Small plasters should be delivered to the patient in an envelope flat, not rolled.



LEFT EAR.

The following directions, accompanying Johnson & Johnson's Perforated Plasters, are worthy of perusal and should be impressed upon the mind of the patient; especially the portion which directs the part to which the plaster is applied to be "clean and dry."

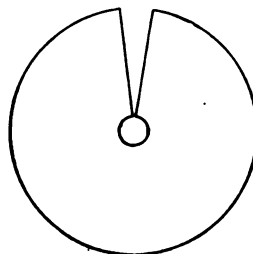
Directions for Using a Plaster.

The part to which the plaster is to be applied should be dry and clean. The object of the printed cloth on the back of the plaster is to prevent the linen being soiled. It should not be removed.

The cloth on the face of the plaster should be removed by pulling it quickly. Having applied the plaster, rub it until it conforms perfectly to the skin.

If the cloth on the adhesive side of the plaster should adhere too firmly, it can be easily removed by dampening, in which case the plaster should be wiped dry before applying.

To remove the plaster: After loosening one corner take firm hold and take off the plaster by a succession of quick jerks. Do not attempt to remove by pulling steadily. A plaster should not be worn longer than necessary to produce the desired effect.



BREAST.

Belladonna Plaster.

NAMES.

Emplastrum Belladonna. (U. S. Ph., Br. Ph., Germ. Ph., Belg. Ph., Swiss Ph., Neth. Ph., Russian Ph.)

Emplatre d'extract de Belladone. French Codex.

Emplasto de Belladonna. Sp.

Emplatre cum Extracto Belladonna. Fr.

Tolkraut Pflaster } Ger.
Belladonna Pflaster }

Tolkirschen Pflaster.

Mekilworth Plaster.

Bela Done Plaster.

Dwale Plaster.

Deadly Night-shade Plaster.

Therapeutic Index.

The following therapeutic uses for belladonna have been compiled from the best known and most recent authorities; only such indications as stand unquestioned and are established by usage and actual practice have been given. The uses of atropine have only been indexed incidentally.

The length of the index precludes more than a notice. In the column opposite the disease will be found one or more well known authorities, whose works may be readily consulted, as to dose and method of administration. The principal works quoted are given in the subjoined list. While many others might have been added only those convenient for reference are given.

Authorities quoted:—

AINSTIE.—Stimulants and Narcotics.
 BARTHOLOW.—Materia Medica and Therapeutics.
 BRUNTON.—Pharmacology, Therapeutics, and Materia Medica.
 BROWN-SEQUARD.—Lectures on Paralysis.
 BECK.—Materia Medica and Therapeutics.
 CULLEN.—Materia Medica and Therapeutics.
 FOTHERGILL.—The Practitioner's Handbook of Treatment.
 GOODELL.—Lessons in Gynæcology.
 HAMILTON.—Nervous Diseases, their Description, etc.
 HARE.—System of Therapeutics.
 LEISHMAN.—A System of Midwifery.
 MEIGS AND PEPPER.—Diseases of Children.
 NAPHEYS.—Therapeutics and Practice of Medicine.
 NIEMEYER.—A Text-book of Practical Medicine.
 NEALE.—Medical Digest.
 POTTER.—Materia Medica, Pharmacy and Therapeutics.
 PHILLIPS.—Materia Medica and Therapeutics.
 PIFFARD.—Materia Medica and Therapeutics of the Skin.
 RINGER.—A Hand-book of Therapeutics.
 SHOEMAKER.—Materia Medica and Therapeutics.
 TROUSSEAU AND PIDOUX.—A Treatise on Therapeutics.
 THOMPSON.—Lectures on Materia Medica.
 WOOD, H. C.—Therapeutics, Materia Medica, etc.
 WARING.—Practical Therapeutics, edited by Buxton.
 WOOD, G. B.—Therapeutics and Pharmacology,
 and others. See also special articles on therapeutic uses of belladonna in this book.

Belladonna.

Indications for Use.

	Authority.
Abscess. —Plaster in contact with inflamed tissue to abort the preliminary inflammation e. g. of breast, also to ease pain and allay irritation.	Ringer, Bartholow, Waring, Hare, Shoemaker, Gasquet.
Acne. —Locally of service to check the abundant secretions of the sebaceous follicles.	Ringer, Brunton.
After-Pains. —As ointment.	Brunton, Leishman.
Albuminuria. —Has been used to diminish the chronic inflammatory condition left by an acute attack.	Neale.

	Authority.
Angina Pectoris. —Belladonna plaster highly useful. (Plaster applied over pain and between shoulders.)	Shoemaker.
Anus, Fissure of. —Locally relieves painful spasms of sphincter.	Brunton, Bartholow, Wood.
Asthma. —Gives relief in paroxysms of asthma and spasmodic difficulty which accompanies emphysema by its influence on involuntary muscle Whenever possible should be used locally. (Plaster applied to chest and spinal-cord covered with a strip one or two inches wide.)	Brunton, Phillips, Hare, Shoemaker, Waring, Wood, Thompson.
Bladder, Irritable. —In the irritable bladder of children more especially causing nocturnal incontinence of urine. In nocturnal incontinence due to relaxation of sphincter or irritable mucous membrane. In almost all varieties of morbid nervous irritability of the bladder, the drug is found soothing and efficacious. — <i>Napheys</i> . (Plaster may be applied over hypogastrium).	Bartholow, Brunton, Brazabon, Goodell. Phillips, Shoemaker, Wood, Thompson. Gross.
Boils. —Few local applications give greater relief to pains, and irritation of boils and carbuncles, than belladonna. Plaster kept in contact with inflamed tissue.	Brunton, Ringer, Heath, Hare. Waring, Bartholow, Shoemaker.
Brain Affections, Hypnotic. —In certain morbid states of the brain belladonna is hypnotic. The indication for its use are prostration, low state of the arterial tension, languid intracranial circulation, a contracted pupil and insomnia. Much good may be expected from belladonna, but harm will be produced if there is much vascular excitement. — <i>Bartholow</i> .	
Bronchitis, Acute. —In acute bronchitis of children, to respiratory centre and to check secretion. (Plaster may be applied to chest.)	Neale, Hare.
Bronchitis, Chronic. —To stimulate respiratory centre. Belladonna arrests the secretion, while, through its action upon the nervous tissues, the sense of breathlessness is overcome, and it will often be found a valuable adjuvant in the treatment of this disease. The same law applies to the treatment of caseous pneumonia. — <i>Shoemaker</i> . (Narrow strip of plaster, one to two inches wide, along the spine from neck to waist, or a piece about 5 x 7 over chest, or both, may be used.)	Neale, Hare.
Calculi, Biliary. —Gives relief during spasm accompanying.	Wood.
Calculi, Renal and Vesical. —Sometimes relieves the pain of the passage of calculus.	Wood, Napheys.
Cancer. —Local use of belladonna of eminent service in the relief of the dreadful pains of cancer; of great benefit in cases of scirrhus and also cancerous and other painful ulcerations. The pain of scirrhus of pylorus, a very distressing malady, has been greatly relieved by the application of Belladonna plaster to the epigastrium.— <i>Phillips</i> .	Brunton, Blackett, Bromfield.

	Authority.
Carbuncle. —A valued remedy to relieve pain when locally applied. Heath recommends also internal use to prevent formation. Plaster covering inflamed tissue.	Brunton, Bartholow, Napheys, Hare, Ringer, Phillips. Waring.
Catarrh, Acute Nasal. —Useful in ordinary colds with sore throat and high fever. Very useful for a commencing cold in the head. — <i>A. A. Smith.</i> In acute nasal catarrh with profuse watery secretion.	Bartholow. Hare. Brunton.
Cerebral Congestion. —One of the best remedies in all hyperæmic condition of the brain or spinal cord.	Phillips.
Cerebro Spinal Affections. —Especially of peripheral nerve spasm of facial muscles. Plaster applied at pressure points or on temples.	Erb.
Chest Pains. —In pleurodynia, plaster useful. (Apply plaster over seat of pain, another at spinal origin of affected nerve.)	Ringer, Hare. Bartholow, Wood.
Chordee. —With camphor and opium, internally gives the best results of remedies administered internally. Locally of service in epididymitis.	Brunton, Hare, Napheys.
Chorea. —Has been found of service in forms attended with much nervous irritability or excitement.	Cullen, Neale.
Coccygodynia. —Plaster useful. (Apply over seat of pain).	Brunton.
Colic, Intestinal. —Especially in children and intestinal spasm. (Belladonna plaster to abdomen.)	Wood, Ringer.
Collapse of Cholera. —Useful to counteract depression of heart's action.	Bartholow.
Conjunctivitis. —Locally and internally.	Brunton.
Conjunctivitis Phlyctenular. —Or atropine in strumous ophthalmia, of great service in relieving pain; constitutional treatment also required.	Waring.
Constipation. —Useful in spasmodic contraction of intestine leading to habitual constipation. Belladonna acts as a stimulant to the muscular folds of intestine and aids effect of purgatives.— <i>De Costa.</i> Belladonna plaster to abdomen as an accompaniment to bath and enema.	Hare, Bartholow, Ringer, Thompson. Wood.
Convulsions, Infantile. —Is of the highest value in certain congestive forms, as in fits due to the irritation of teething, or those referable to whooping-cough.	Trosseau, Marchesod.
Cough. —In nervous and spasmodic cough has proved serviceable. Belladonna plaster applied to chest useful in cough arising from uterine disease.— <i>Shoemaker.</i> (Also a two inch strip of plaster over dorsal portion of spine.)	Phillips.
Cramp. —Muscular from injury to nerve trunk often remarkably relieved, "late rigidity" occasionally removed or diminished, affording relief to an inconvenient deformity. — <i>Bartholow.</i> (In long continued cramp plaster may be used over spinal origin of affected nerve.)	Ringer, Wood, Waring, Shoemaker.

	Authority.
Croup. —The essential cause of asphyxia in croup seems to be the paralysis more or less complete of the pneumogastric. This is shown by the difficulty and often impossibility of producing vomiting. Belladonna being an excitant of the pneumogastric is specially indicated.	De Ponterea. <i>La Union Medicale.</i>
Cystitis, Acute. —Is good remedy in almost every form of vesical irritation, when the vesical mucus is irritable, very useful in recent catarrh from chill with pain. (Plaster over hypogastrium.)	Goodell, Bartholow, Phillips.
Delirium. —In delirium of typhus.	Brunton.
Delirium Tremens. —Of proven efficacy in congestion of the brain (<i>Phillips</i>); useful for the insomnia when coma vigil, cold surface, cyanosi.— <i>Bartholow.</i>	Brunton,
Dentition. —In convulsions of dentition rarely fails to relieve.	Brunton, Phillips.
Diarrhœa. —In colliquative diarrhœa. In acute dysentery belladonna both internally and externally is often efficacious.— <i>Napheys.</i>	Delping, Wood, Hare.
Diphtheria. —A commencement especially useful when tonsils are swollen and there is little exudation; later on, to support the heart.— <i>Bartholow.</i> Especially useful in sore throat and tonsils are acutely inflamed.— <i>Ringer.</i> When there is much depression most excellent remedy. If used before exudation has spread and consolidated into membranous plaques it seems to have power to hinder the formation of the exudation.— <i>Bartholow.</i>	
Dysmenorrhœa. —In neuralgia and spasmodic forms, dark and fetid discharge, crampy pain, and cold chills, a suppository or mild injection together with internal administration will relieve (<i>Phillips</i>); in neuralgic dysmenorrhœa it will permanently relieve.— <i>Bartholow.</i> Plaster applied to sacrum often of benefit.— <i>Napheys.</i>	Hare, Anstie, Wood, Beck.
Dyspepsia. —To lessen pain and constipation. (Plaster over seat of pain.)	Ringer.
Dysuria. —Has sedative effect in vesical and urethral irritation. (Plaster over hypogastrium.)	Phillips.
Eczema. —Internally or subcutaneously, in acute stage.	Bartholow.
Emissions and Erections. —In emissions, where genitalia are relaxed, atonic state; produces good results, even in extreme cases of emissions. Prevents erections and consequences useful in nocturnal emissions due to irritation of the bladder. (Plaster over sacrum.)	Waring, Bartholow, Heustia.
Epilepsy. —In petit mal in nocturnal epilepsy and in anæmic subjects; perseverance in its use is required. Especially of service in epilepsy from emotional excitement. Marked benefits are derived from its anti-spasmodic properties.— <i>Wilks.</i> May be advantageously combined with bromides. — <i>Gasquet.</i>	Brunton. Trousseau, Wilks, Harley, Phillips, Bayle, Hamilton.
Epistaxis. —When of congestive origin.	Brunton, Phillips.

	Authority.
Erysipelas. —Possesses a real curative power especially in idiopathic and facial erysipelas. Has astonishing power in superficial and non-vesicular forms, also when erysipelas attacks the brain, and in phlegmonous type.— <i>Phillips</i> . Also when adynamia; if much fever, may be combined with digitalis or aconite; when much depression with quinine (<i>Bartholow</i>); of service locally applied over the surface (<i>Quain</i>); should be used both internally and externally, may be combined with aconite.— <i>Ringer</i> .	Wood, Napheys.
Erythema. —Useful in cases resisting ordinary treatment.	Bartholow.
Eye Diseases. —Locally and internally in iritis, conjunctivitis, and other inflammations (which see). Locally of great service in strumous ophthalmia to relieve pain.	Potter. Waring, Carter.
Feet. —To check fetid secretions. (Apply plaster to soles of feet.)	Ringer, Hare.
Fevers —In the eruptive fevers, especially scarlatina (<i>Bartholow</i>); in typhus, with delirium, insomnia, painful sensitiveness to light and sound. In all hyperæmic states of brain and spinal cord. Is prophylactic often against scarlet fever (<i>Phillips</i>). In delirium, also excellent in typhus.— <i>Ringer</i> . Very useful in febricula, especially for head symptoms and constipation.— <i>Phillips</i> .	Piffard.
Flatulence. —If due to paresis of intestinal walls. (Plaster over abdomen.)	Bartholow.
Gastralgia and Gastrodynia. —Is useful in painful affections of the stomach. In pain accompanying gastric ulcer, pyrosis, irritative dyspepsia. (Plaster applied to the epigastrium or over the dorsal portion of the spine.)	Ringer, Bartholow.
Glandular Enlargements. —Of great value for anodyne. Has some antisudorific action. Resolvent or discutient powers formerly claimed.	Brunton, Pariera, Gattaker, Cullen, Blackett, Bromfield.
Gout. —The best remedy to effectually and speedily soothe pain.— <i>Phillips</i> .	Neale.
Hæmorrhage. —For irritable and bleeding rectal ulcers. (Intestinal.)	Brunton, Phillips.
Hæmorrhoids. —	Neale.
Hay Fever. —When nasal secretion is very profuse. — <i>Bartholow</i> . (Plaster sometimes useful applied to chest.)	
Headache. —Frequently given in frontal headache, especially at menstrual period, or from over study and fatigue. — <i>Ringer</i> . Relieves cerebral congestion, and distress from light and sound (<i>Phillips</i>); pain over brows and eyeballs—often due to stomach or uterine derangements—especially in young women.— <i>Potter</i> . (Plaster over stomach or sacrum according to origin of pain.)	Hare.

	Authority.
Heart-Burn. —Waterbrash. (Plaster over epigastrium).	Bartholow.
Heart Depression. —Counteracts sudden and temporary depression of heart's action e. g. collapse of cholera. — <i>Bartholow.</i>	
Heart, Dilatation of. —Belladonna is one of the best agents that can be employed to overcome irregularity of the action of the heart and to relieve pain. A plaster 4x4 to be worn over cardiac region.	Bartholow, De Costa.
Heart, Fatty. —	Brunton.
Heart, Irritable. —Belladonna plaster persistently worn is productive of much good.— <i>DeCosta.</i>	Napheya.
Heart, Palpitation of. —Useful in cardiac strain. Very often rest in bed with a Belladonna plaster over the heart soon causes palpitation to cease. Belladonna plaster will often prove most acceptable for the relief of cardiac neuroses such as occur in the course of long continued disease, as typhoid fever, rheumatism, phthisis, pulmonalis, and the peculiar irritability which accompanies aneurism, thoracic, and abdominal. as well as that which occurs as an accompaniment of anæmia; the use of belladonna plaster is highly recommended in case of angina pectoris, but of course this method of procedure is but a temporary expedient, and is not curative in the strict sense of the term.	Neale, Wood, Waters, Napheya.
Heart, Valvular Disease. —Belladonna is superior to digitalis. Plaster over the heart combined with rest efficacious. — <i>A. T. Waters.</i>	Shoemaker. Napheya.
Hemicrania. —If due to vaso-motor spasm, the face being pallid; also if disease be of reflex character.	Hamilton.
Hernia. —In strangulated, anti-spasmodic action contributes toward spontaneous reduction; relieves vomiting. Applied direct to hernia often causes reduction in size of tumor.	Lagorsky. Magleria.
Herpes Zoster. —In intercostal neuralgia attendant upon herpes zoster gives effectual relief. (Plaster over seat of pain and at spinal origin of affected nerve.)	Bartholow, Waring.
Hiccough. —Useful for antispasmodic action. (Plaster over epigastrium.)	Wood, Hare, Shoemaker,
Hydrophobia. —In all hyperæmic states of the brain and spinal cords, is one of the very best remedies.	Brunton, Phillips.
Hyperidrosis. —Of drugs, belladonna antagonizes hyperidrosis of jaboranda.— <i>Bartholow.</i>	
Hysteria. —	Neale.
Incontinence of Urine in Children. —Valuable in these cases. (Plaster over sacrum or hypogastrium or both.)	Sir H. Thompson, <i>Diseases Urinary Or-</i> <i>gans.</i>

	Authority.
Inflammation. —Belladonna, being stimulant to circulatory apparatus is useful in gouty and rheumatic inflammation and cystitis.	Neale.
A remedy of great efficacy in certain acute inflammation of air passages.	Wood.
Pain of inflamed parts, especially gouty and rheumatic inflammation, can often be more speedily and effectually soothed by this remedy than by any other.	
In erysipelas, inflammatory sore throat, ancephalitis, gouty and rheumatic inflammation, cystitis, pneumonia, etc.; both locally and internally in inflammation of the eye; is effectual in inflammation which threatens to end in abscess.	Phillips, Ringer.
In many forms no remedy more useful, notably scarlet fever, erysipelas, low fevers. Inflammation of the eyes, boils, carbuncles, etc., useful externally and internally.	Bartholow.
External or local inflammations.	Heath, <i>London Prac.</i> , 1868.
Mamma; acute inflammation.	
Neck; inflammatory swelling of glands.	Hare.
Inflammation of lower jaw depending upon areolar abscess.	
Painful sympathetic affections.	
Sympathetic bubos.	
Applied by covering well affected part.	
(Plaster over affected part in early stages.)	
Insomnia. —Indications for its use coma vigil, restlessness, weak action of heart, cold surface, cyanosis, clammy sweat.	
Hypnotic in some morbid states, especially marked by prostration, low arterial tension, contracted pupils.	Ringer,
In conditions of hyperæmia of cerebro-spinal centres excitement with elevated pulse increased arterial tension will do harm.	Bartholow.
Intestinal Obstruction. —Often successfully employed when from want of tone and partial spasm.	Trousseau.
Intussusception. —Has been successfully used.	Waring.
Iritis. —Internally and locally of greatest value in iritis, syphilitic, idiopathic, painful iritis, rheumatic, scrofulous ophthalmia.	Neale, Ringer, Waring, Phillips, G. B. Wood, Hare.
To allay deep seated pain which so generally accompanies these diseases.	
To prevent iris from becoming implicated in the ulcerative process.	
Sometimes atropia fails or irritates, the ointment or plaster may then be applied to temple with success.	Lanson, London.
Labor. —Topically of great service in long protracted labors from rigidity of os and cervix.	Hamilton.
Lactation Excessive. —Internally and locally.	Shoemaker.
Laryngismus Stridulus.	Brunton, Wood, Hare, Shoemaker
Leucorrhœa. —For over-secretion and pain. (Plaster over sacrum.)	Ringer.
Locomotor Ataxia. —Belladonna and ergot highly recommended (<i>Brown-Sequard</i>); gives great relief to pain. — <i>Atkinson</i> . (Plaster over the spine.)	Brunton. Napheys.

	Authority.
Lung Diseases. —Is frequently of great benefit in pulmonary oedema, to retard exudation of serum and to counteract the failure of heart. (Plaster applied to chest.)	A. A. Smith.
Lumbago. —Plaster very useful for persistent lumbago especially when confined in one spot.	Phillips, Bartholow, Ringer.
Lymphangitis. —Local application freely applied of great service when pain is severe.	Waring.
Mania. —Is useful especially in monomania, with fixed hallucinations, though a large dose causes a temporary insanity; one of the very best remedies in all hyperæmic conditions of the brain.	Trousseau, Phillips.
Mastitis. —See Lactation. In recent induration and in inflammation remarkable effects are produced by belladonna in arresting secretion of milk.— <i>Atkinson</i> . Combined with morphine and chloral, when much pain (<i>Bartholow</i>); especially useful to check secretion of milk when inflammation is imminent (<i>Ringer</i>), or when distended with milk (<i>Phillips</i>); when inflammation has set in continuous application of belladonna for 24 hours often arrests it.— <i>Ringer</i> .	Fordyce Barker, Playfair. Wood, Hare.
Mastodynia. —Belladonna plaster very useful.	Sir Astley Cooper.
Melancholia. —	Neale.
Meningitis, Cerebro-Spinal. —In all hyperæmic conditions of brain and spinal cord, especially during stage of excitement. Strongly to be relied on, even when brought on by external violence.	Brunton, Phillips.
Metritis. —Simple. Belladonna plaster over hypogastrium will give ease and subdue inflammation.	Phillips. Robt. Barnes, London.
Migraine. —When due to vaso dilated conditions, best remedy to use in urticaria due to oedema of the connective tissue of the skin; as the result of an active vaso-motor dilation.	Légois.
Myelitis. —In various forms of myelitis, belladonna plaster lessens congestion of the spinal cord and diminishes its reflex irritability. In connection with other treatment a large belladonna plaster on the back will give decided effects.— <i>Brown-Sequard</i> .	Brunton.
Myalgia. —Belladonna plaster often successful. (Apply over pain.) Uterine, ovarian, dysmenorrhœa. Painful and irritable states of uterus. In all these cases of course it is necessary to remove if possible all local or temporary sources of irritation. They are benefited by the application of belladonna plaster to the sacrum continued for several weeks; keeping watch for toxic symptoms. Plaster should be removed in 3 to 5 days and renewed if necessary.	Neale, Ringer, Brunton, Bartholow. Anstie, Wood.

Nausea.—See Vomiting.

Nephritis Acute.—(Bright's Disease.)

Will calm nervous irritation and at the same time contract the dilated vessels.

Neuralgic Affections.—Belladonna displays its most useful powers; few remedies more effectual in their cure. May be used both internally and externally when the pain is near the surface, or in any position to which near access can be obtained, generally advisable to depend on the topical use of the remedy, or to employ it in the two methods jointly. The general rule is to administer it in quantities sufficient to produce obvious effects without going so far as to cause delirium, stupor or dimness of vision approaching blindness. Plaster an effectual form of application.

In neuralgia of the limbs or trunk the application should be made as near to the seat of pain as possible; and in these, the endermic method will often be advisable. In sciatica, which is one of the most obstinate forms of the affection, the blistered surface should be made in the course of the nerve as it passes out of the pelvis.

(Plaster over spinal origin of affected nerve.)

In the internal neuralgic affections of the abdomen, as gastralgia, enteralgia, nephralgia, etc., the external use of the medicine should be resorted to when the complaint is complicated with vomiting or purging, while opium is used internally. (Plaster over pain.) The contrary condition of constipation, it would be better to try the effects of belladonna internally.—*G. B. Wood.*

Belladonna whether used internally or externally ranks first among sedatives and anodynes in neuralgia.

Must be persisted in by application. In vicinity of nerve has special utility in tic douloureux and sciatica; also in peri-uterine and dysmenorrhoeal neuralgias.

—*Bartholow.*

Plaster over pain and origin of affected nerve.

Spinal irritation, intercostal neuralgia. Plaster very useful along course of nerve. Continue for several days.—*Trousseau.*

And among neuralgic pains those are by far the most frequently and effectually relieved the main source of which is some peripheral disturbance. Belladonna is much more serviceable, for example, in the various painful affections which are produced by an irritated state of the pelvic organs (especially in females) than in neuralgia of the face.—*Phillips.*

In neuralgia of the eye belladonna plaster around the orbit relieves exalted sensibility, acute pains and intolerance of light.—*Audibert.*

New Growth.—Polypi, laryngeal warts, etc. The growth of new formation often checked by application of belladonna plaster.—*Napheys.*

Orchitis.—When inflammation has subsided.

Ovaritis.—Useful in the pelvic spinal and neuralgic pains. Belladonna plaster applied over ovary or sacrum.

Authority.

Neale.

Ringer, Neale, Wood.
Phillips.
Jour. Des Con Medicas,
Shoemaker.

Phillips,
Wood, Hare.

Brown-Sequard,
Shoemaker,
Atkin,
Fuller.

Hammond,
Tilt.

Ringer, Wood,
Bartholow, Neale.

Waring.

John Tilt.

	Authority.
Pain and Nervous Irritation. —Abates and in some cases completely removes pain. To be successful requires in many cases to be persevered in until dryness of the throat and disordered vision is produced.— <i>Pareira</i> . Stands in front rank in list of sedatives and anodynes as an internal and external remedy but like all other remedies occasionally fails.— <i>Waring</i> . Especially adapted for cases marked by spasmodic twitchings of the muscles whether manifested by cramp or starting of the limb. (Plaster over spine or over seat of pain or cramp.) Action should be watched or discontinued when constitutional effects manifest themselves. Local application should be applied along the course of the nerve.	Bailey. <i>Use of Belladonna</i> .
Paralysis. —When depending on chronic inflammation of the cord (<i>Ringer</i>); Plaster externally along spine, with ergot internally.— <i>Brown-Sequard</i> .	Fuller
Pemphigus. —	Trousseau.
Perspiration. —Useful in idiopathic local sweatings. Best remedy we have for night sweats. Especially useful for weakly children who sweat profusely. For excessive and offensive perspiration.	Bartholow. Wood, Hare, Ringer.
Pertussis. —See Whooping Cough.	Thompson.
Pharyngitis. —Useful in acute attacks (<i>Bartholow</i>); when temperature is high (<i>Ringer</i>); relaxes the pharyngeal muscles.	Hare, Neale, Wood. Neale, Wood.
Phlegmasia Alba Dolens. —Locally with mercury often of much benefit.	Brunton, Waring.
Phlegmon. —Certainly efficacious. (Plaster over involved surface.)	Brunton.
Phimosis. —Locally has proved effectual.	Brunton, Waring.
Photophobia. —To eye.	Ringer.
Phthisis. —Locally for pain in muscles. (Plaster over pain).— <i>Brunton</i> . Best remedy for night sweats (<i>Hare</i>); useful remedy for the case as inflammation in the stage of deposit immediately succeeding the stage of catarrhal inflammation and before softening and extrusion. No remedy so generally effective for sweats of Phthisis.— <i>Bartholow</i> . Seems to act beneficially on the general course of the disease.— <i>Napheys</i> .	Fothergill.
Pleurisy. —Belladonna plaster most useful to relieve pain in old adhesions. (Apply over pain.)	Hare, Brunton.
Pleurodynia. —(See chest pains.) Plaster very useful as local anodyne.	Ringer, Hare.

	Authority.
Pneumonia. —Acting as stimulant to circulatory apparatus. As an adjuvant to digitalis in infantile pneumonia to soothe the irritable nervous system and curtail superabundant secretion. Useful in collapse. (Plaster along spine and over chest)	Brunton, Hare, Wood
Prurigo and Pruritus. —Controls cases which have resisted ordinary treatment.	Brown.
Ptyalism. —A very useful antisudorific. Effectual in mercurial ptyalism and that of pregnancy.	Bartholow.
Puerperal Convulsions. —Of verified utility.	Hare, Neale, Bartholow, Wood.
Puerperal Fever. —When local inflammation is attended with excruciating pain (of common occurrence) apply over suffering part a blister removing cuticle and then lay on a belladonna plaster; Belladonna and opium sometimes used. The effect is so tranquilizing as to do away with the necessity of narcotics internally, must be carefully watched for symptoms of narcotism. May be continued as long as there is abdominal tenderness.	Phillips, Brunton.
Puerperal Mania. —Useful in collapse.	Atkinson, Crawcour.
Rectum, Diseases of. —Locally in fissure and irritable ulcers; internally and locally to remove ulcers, also excellent in burning pain following defaction.	Wood.
Rheumatic and Gouty Disease. —May be treated with the internal and external use of belladonna; has been employed even in acute rheumatism. In the nervous or neuralgic forms of these diseases that belladonna is especially indicated; frequently serviceable in the shifting forms of subacute rheumatism without fever; and, in the chronic forms of the same disease is a standard remedy, given in connection with one or more various alteratives used. In this form of the disease it may be also advantageously employed locally, in the form of plaster; applied to the joints, over muscular parts into the small of the back in lumbago, and to the side in pleurodynia.	Ringer, Phillips.
Rheumatism, Acute. —In rheumatic fever action is speedy, direct and enduring, rendering opium necessary. Application over the affected joints as soon as the first indication of inflammatory action arises in the part.	G. B. Wood.
Rheumatism, Chronic. —Causes immediate cessation of migratory or flying pains, but affects fixed rheumatic pains only slightly. (Plaster over pain.)	Neale, Harley.
Scarlatina. —During the eruptive state, when depression exists, and rash is imperfectly evolved.—(<i>Bartholow.</i>) As prophylactic has been recommended; is often efficacious as prophylactic (<i>Phillips</i>); the preponderance of evidence is certainly in favor of such use of the drug (<i>Piffard</i>); this virtue is claimed by imposing authorities.— <i>Trousseau.</i>	Brunton.
Scarlet Fever. —	Osborn.
	Neale.

	Authority.
Sciatica. —Of utility, relief if afforded apt to be permanent. Local applications can be employed with great benefit. Plaster to be laid along course of nerve; also over sacrum.	Ringer, Bartholow, Napheya. Ainstie.
Sea-Sickness. —Plaster useful in vomiting. (See article by De Mussy, this volume.)	Neale. Bartholow.
Skin Diseases. —Belladonna is useful in the cutaneous necrosis, prurigo, herpes zoster, erythema, eczema, etc. Cases which resist ordinary treatment yield to belladonna. Hyperidrosis (colliquative sweating), unilateral sweating and other forms of profuse transpiration through the skin are arrested by internal and local application of belladonna. (See article by John V. Shoemaker, this volume.)	Piffard.
Sneezing. —	Neale.
Spasm or Muscular Rigidity. —Spasms of the stomach, bowels, ureters, hepatic ducts, etc., and those of tetanus, do not yield readily to belladonna. Has been used in tetanus, and in certain colicky affections with success. In painless spasms is often highly beneficial, not only yields relief but serves, as in neuralgia, to make a permanent impression on the nervous centres. (Plaster over sacrum.) The patient should be kept under very moderate influence for a long time, with occasional intermissions. In muscular rigidity, its local application has been found very useful in a number of different cases. (Plaster over rigid muscle; also over spinal origin of affected nerve.) Constrictions of the sphincters of the anus and neck of bladder, and in spasm of the urethra, and in the urethral affection. (Plaster over sacrum.) Rigidity of the os uteri in delivery is said sometimes to yield to the local application. It has been employed externally in strangulated hernia, to produce relaxation of the abdominal muscles.— <i>G. B. Wood.</i> (Plaster over hernia or cramp.)	
Spermatorrhœa. —In relaxation of the genital organs where there is no dream nor orgasm; one fourth of extract and a grain and a half of zinc sulphate. (Plaster over sacrum.)	Bartholow, Ringer.
Spinal Irritation. —Gives way to belladonna more readily than to aconite. (Plaster along spine.)	Ringer, Bartholow.
Spinal Paralysis and Softening. —In chronic inflammatory conditions.	Ringer.
Strabismus. —For the strabismus of encephalitis— <i>Phillips.</i>	
Stricture. —Œsophagus. Plaster over sternum useful as a palliative. (Also over the cervical and dorsal spine.)	Waring.
Sunstroke. —	Brunton.

	Authority.
Suppression of Urine. —Whether accompanied by urania or not belladonna is indicated, as both the sluggish circulation and the torpid kidney are simultaneously aroused by the drug there is ground for expecting a restoration of the renal secretion. (Plaster over kidneys.)	Harley.
Syncope. —In cardiac syncope.	Neale, Wood
Syphilis. —Locally with mercury for secondary ulcerations of rectum.—(<i>Phillips</i>). Sometimes useful instead of mercurials.— <i>Sturgis</i> .	
Testicle, Diseases of. —In neuralgia of the testis. As an ointment with glycerine in epididymitis or orchitis.	Brunton.
Tetanus. —Acts by reducing congestion of the blood vessels of the spinal cord and its membranes.— <i>Brown-Sequard</i> . Spine and rigid muscles covered with belladonna plaster under careful watching may be renewed every 12 hours. Belladonna should also be given internally and applied direct to wound. Should be continued for some weeks. Local application of aconite and belladonna to wound diminishes irritability of wounded part. Successfully used in many cases: the extract internally, and locally to wound (<i>Waring</i>); gr. 1.125, atropine injected into muscle (<i>Brunton</i>); bleeding, vapor-baths, and large doses of belladonna have cured tetanus.— <i>Trousseau</i> . Spine and rigid muscles to be covered with belladonna plaster.— <i>Oliver, London</i> .	Hutchinson, Oliver.
Throat, Sore. —Relieves spasm of the pharyngeal muscles; also when the tonsils are much inflamed and swollen. Aphonia of the vocal chords and hysterical aphonia may be quickly relieved.— <i>Bartholow</i> . In tonsillitis internally until constitutional signs are produced, also externally to throat.— <i>Napheys</i> .	Napheys.
Tic Douloureux. —Of special utility, relief apt to be permanent.— <i>Bartholow</i> . Ranks first among sedatives and anodynes in this and other neuralgic affections.— <i>Anstie</i> . Plaster over affected part and at nape of neck.	Hare, Neale, Ringer, Wood, Phillips
Tonsillitis. —Often of surprising efficacy.— <i>Phillips</i> .	Hawks, Tanner.
Toothache. —	
Torpid Fevers (vide Fevers).—Excellent results have been obtained from the use of belladonna. It is indicated when there is low, muttering delirium, subsultus, and stupor and is contra-indicated in the condition of delirium.— <i>Bartholow</i> . Thought to counteract the poison of typhoid.— <i>Waring</i> .	Brunton.
Torticollis. —Liniment.	Brunton.
Trismus. —Extract in large doses.	Neale.
Typhlitis. —	Brunton.

Typhus Fever.—To cleanse and moisten the tongue; controls the delirium, slows and strengthens the pulse, reduces the temperature, shortens the course of disease (*Ringer, Phillip*). In early stages relieves severity in symptoms.—*Neale*.

Ulcers and Sores.—Has a remarkable influence over various ulcerative processes.—*Phillips*.

Variola.—Successfully used both as prophylactic and curative agent (*Erasmus Wilson*); to relieve dilatation of pupil and some stupor, found effectual.—*Waring*.

Vomiting of Pregnancy.—Plaster over the epigastrium very effective in relieving.

Plaster useful also in vomiting cerebral or reflex, in seasickness.

Internal use has not same effect; other narcotics do not produce same benefits.

Whooping Cough.—Its efficacy depends in part on its lessening necessity of respiration, as well as its power in obviating spasm of the bronchial tubes and of decreasing the susceptibility of the bronchial membrane to the influence of the exciting causes of paroxysms.

Most effective in spasmodic whooping cough. In order to be curative physiological effects must be produced. Most obvious effects in those cases characterized by profuse bronchial secretion.—*Bartholow*.

Belladonna plaster applied to chest and spine may be used to advantage.

Yellow Fever.—

Authority.

Wood.

Tannier,
Tilt,
Bartholow,
Greenhadough.

Schaeffer,
Wetzler,
Laeneck,
Diseases of Chest,
Thompson.

Beck.

Fuller,
Gawaway,
Thompson.

Brunton.

Applying Belladonna Plasters.

Things Worth Remembering.

Patients are apt to wear a plaster three or four weeks, or "until it comes off." They will do this unless specially instructed by the physician to the contrary. This procedure may sometimes prove very harmful, as the continued absorption of belladonna, by the skin, is very apt to produce the constitutional poisonous effects of the drug. Fresh belladonna plasters applied for a short time, and their application repeated, if necessary, will give more satisfactory results than if one plaster is allowed to remain.

By
A. H. Laidlaw, M. D.,
New York.

The physician should see that the spot to which the plaster is to be applied is well

cleansed and dried. Soap and water, warm alcohol or vinegar, cologne water or bay rum are good cleansing agents.

The exact spot to which the plaster is to be applied should be indicated. (Kobart commends marking the skin with a pencil.) The patient should be told just when to take off the plaster. In cases of pain and inflammation, it can be generally controlled in from 3 to 5 days. The plaster should be removed, and the drug withheld until there is a fresh indication for its use.

The exact size of the plaster should be indicated. Patients sometimes cover their entire back with belladonna plasters where a strip one to two inches wide along the spine, or a small piece over the spinal origin of the affected nerve would be more effectual. Covering too large a surface with belladonna plaster is sometimes dangerous; always useless. Children are very susceptible to belladonna. For children under 4 years of age a piece 1 1/4 x 2 inches, or one-fourth the regular porous plaster size, is usually sufficient at one time. For children between 4 and 8 years of age a piece 2 1/2 x 4 inches, or about one half the size of an ordinary plaster, will be effectual.



OLD-STYLE BELLADONNA PLASTER.



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